APPENDIX A

ConBAR Examples

Example 1: Extensive Damage

Member Observations:

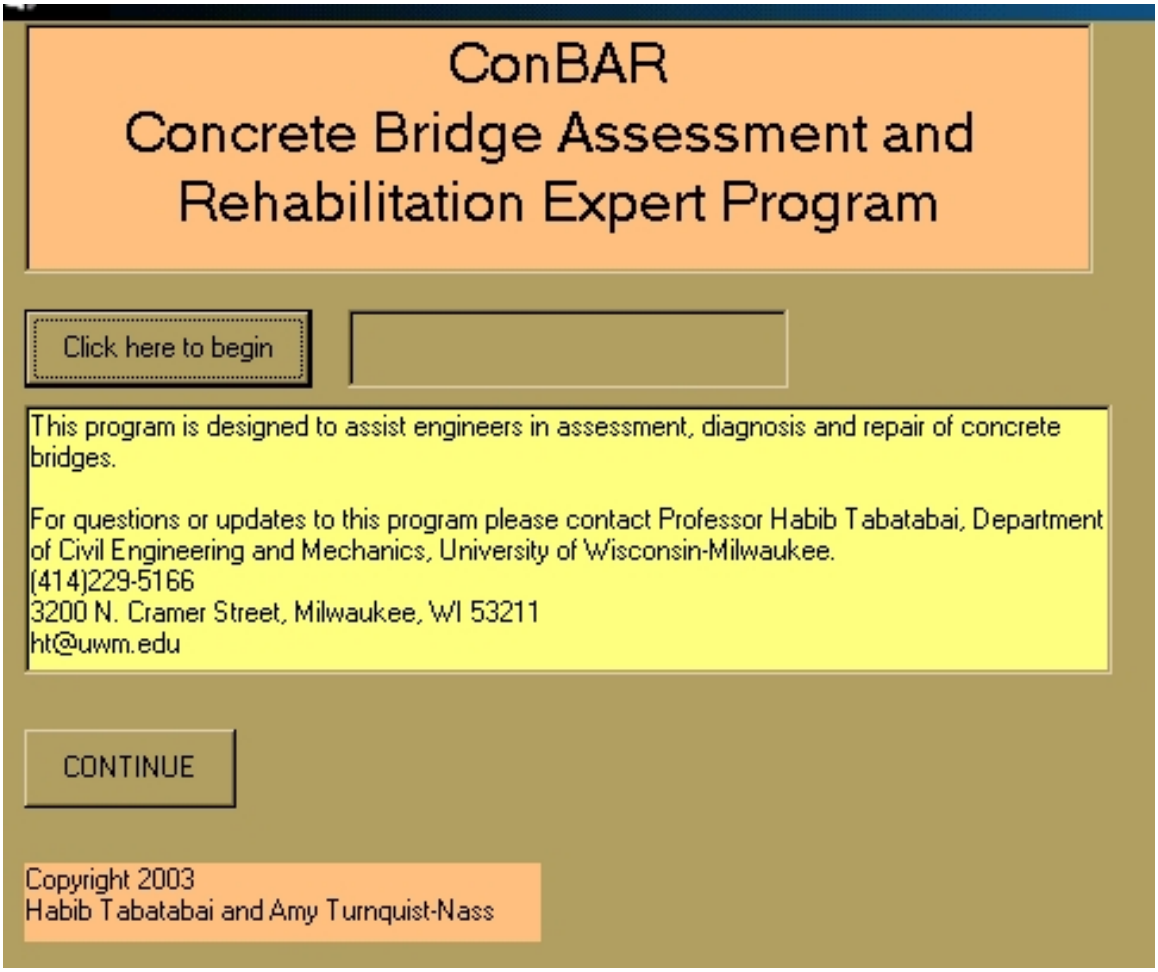
The member under consideration is a beam located on a 25-year-old prestressed concrete girder bridge in Wisconsin. The beam end zones are exhibiting signs of distress. This 2-span bridge is located in a metropolitan area with an ADT of 18,500. The bridge carries a state highway and spans over another state highway. It is not located near industrial sites with harmful emissions, but does carry heavy trucks. There are no weight limits posted and the bridge has not been classified as structurally deficient or functionally obsolete. Inspectors have given a rating of five to the beams. No vehicle impact damage has occurred and no previous repairs have been performed on the beam. The bridge does have leaky expansion joints, and no support settlement is observed.

Cracking is observed in the beam end zones, generally around spalled and spalling areas with crack lengths less than 12 inches. The cracks are not related to extraordinary loading and not related to flexural or shear loading. It is unknown if the crack planes run through the aggregates and no residue is observed around the cracks. The cracks have not been observed to move noticeably with temperature changes.

No other surface defects such as honeycombing, blistering, abrasion, scaling, or popouts are observed. Delaminations and spalling on about 15% of the affected member zone (beam ends) are observed. The bridge deck has been overlaid with and asphaltic overlay.

Although testing has not been performed, alkali silica reactivity (ASR) is not suspected. The sulfate content is low. The depth of the carbonation front is unknown. The member is exposed to deicing salts through leaky expansion joints. A testing laboratory has measured chloride contents in the affected zone. The water-soluble chloride contents at the depth of cover and half the depth of cover are 0.16% and 0.35% by weight of cement, respectively. The permeability of the concrete is not measured and is therefore unknown. Corrosion stains are observed on the concrete surface in the beam-ends, and moderate rust is observed on the exposed steel. The steel is not epoxy coated. The actual compressive strength of concrete is unknown since coring for tests have not been performed. The overall concrete quality is judged to be average.

A printout of the ConBAR session is presented on the following pages.


ConBAR
Concrete Bridge Assessment and Rehabilitation Expert Program
Click here to begin
This program is designed to assist engineers in assessment, diagnosis and repair of concrete bridges.
For questions or updates to this program please contact Professor Habib Tabatabai, Department of Civil Engineering and Mechanics, University of Wisconsin-Milwaukee.
(414)229-5166
3200 N. Cramer Street, Milwaukee, WI 53211
ht@uwm.edu
CONTINUE
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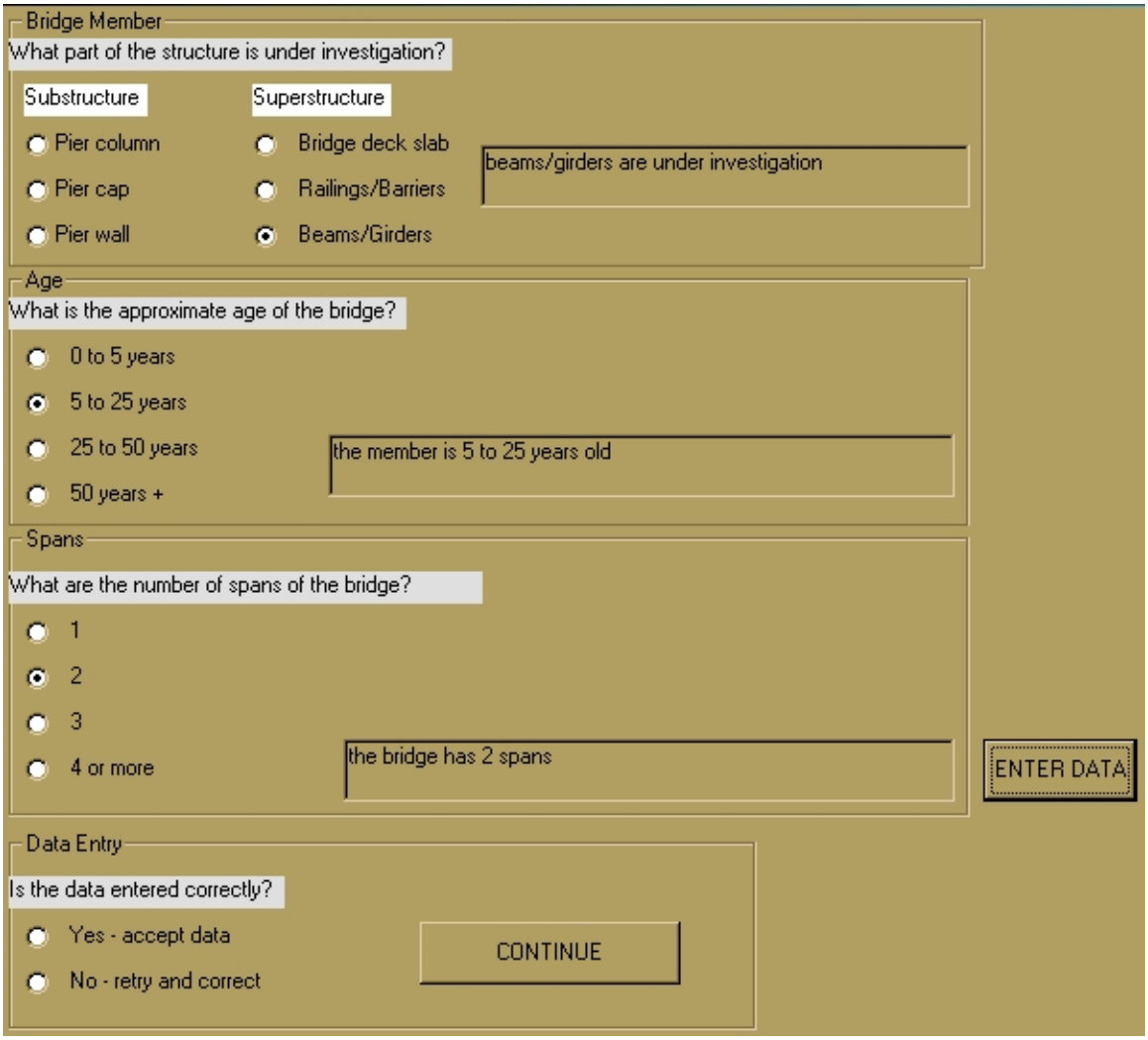
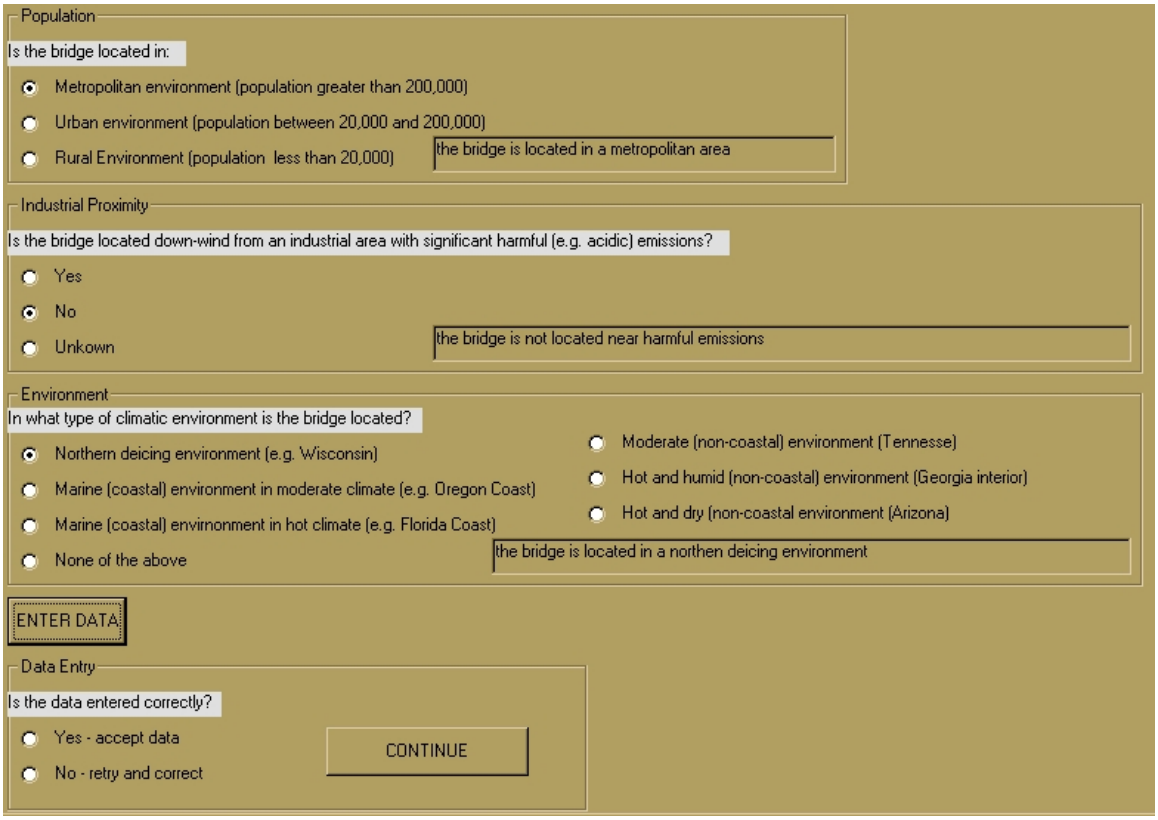
Habib Tabatabai and Amy Turnquist-Nass


Bridge Member
What part of the structure is under investigation?
Substructure
Superstructure
Pier column
Pier cap
Pier wall
Bridge deck slab
Railings/Barriers
Beams/Girders
beams/girders are under investigation
Age
What is the approximate age of the bridge?
0 to 5 years
5 to 25 years
25 to 50 years
50 years +
the member is 5 to 25 years old
Spans
What are the number of spans of the bridge?
1
2
3
4 or more
the bridge has 2 spans
ENTER DATA
Data Entry
Is the data entered correctly?
Yes - accept data
No - retry and correct
CONTINUE


Population
Is the bridge located in:
Metropolitan environment (population greater than 200,000)
Urban environment (population between 20,000 and 200,000)
Rural Environment (population less than 20,000)
the bridge is located in a metropolitan area
Industrial Proximity
Is the bridge located down-wind from an industrial area with significant harmful (e.g. acidic) emissions?
Yes
No
Unkown
the bridge is not located near harmful emissions
Environment
In what type of climatic environment is the bridge located?
Northern deicing environment (e.g. Wisconsin)
Marine (coastal) environment in moderate climate (e.g. Oregon Coast)
Marine (coastal) environment in hot climate (e.g. Florida Coast)
None of the above
Moderate (non-coastal) environment (Tennesse)
Hot and humid (non-coastal) environment (Georgia interior)
Hot and dry (non-coastal environment (Arizona)
the bridge is located in a northen deicing environment
ENTER DATA
Data Entry
Is the data entered correctly?
Yes - accept data
No - retry and correct
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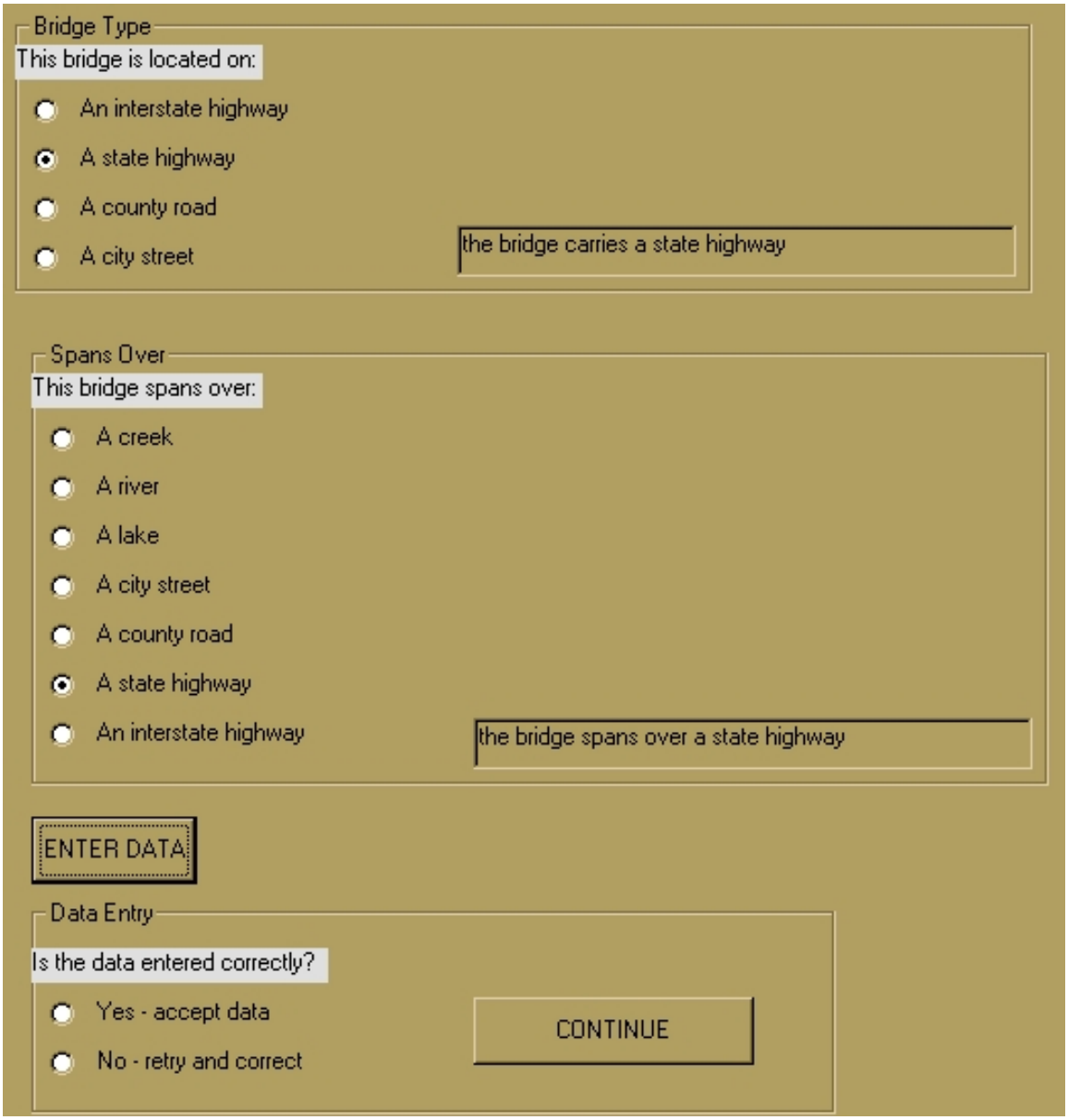
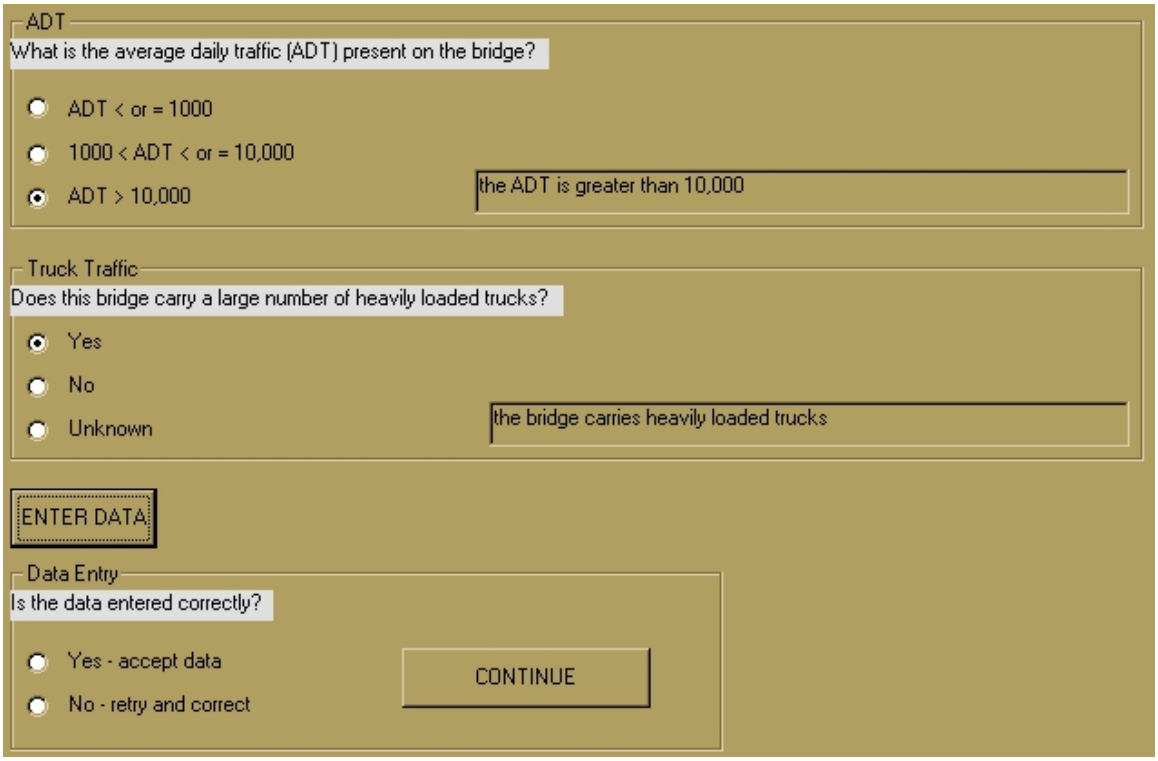
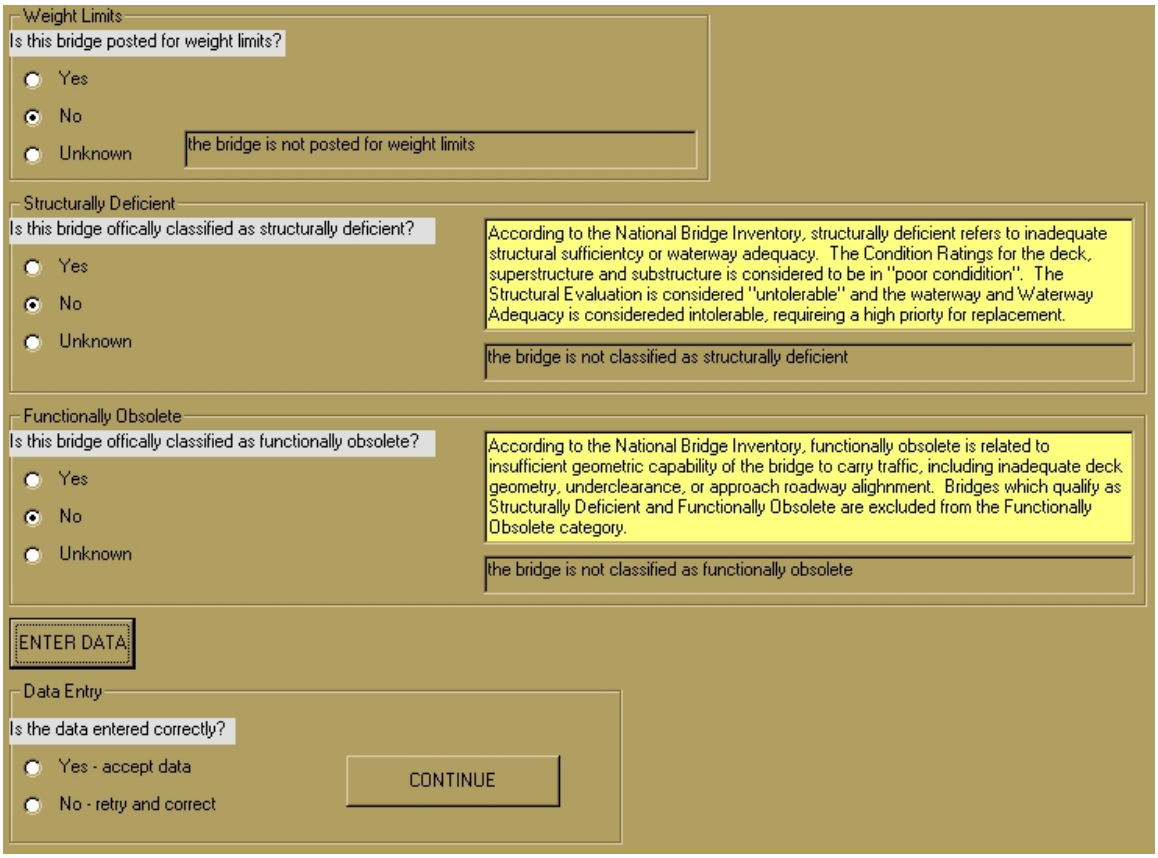
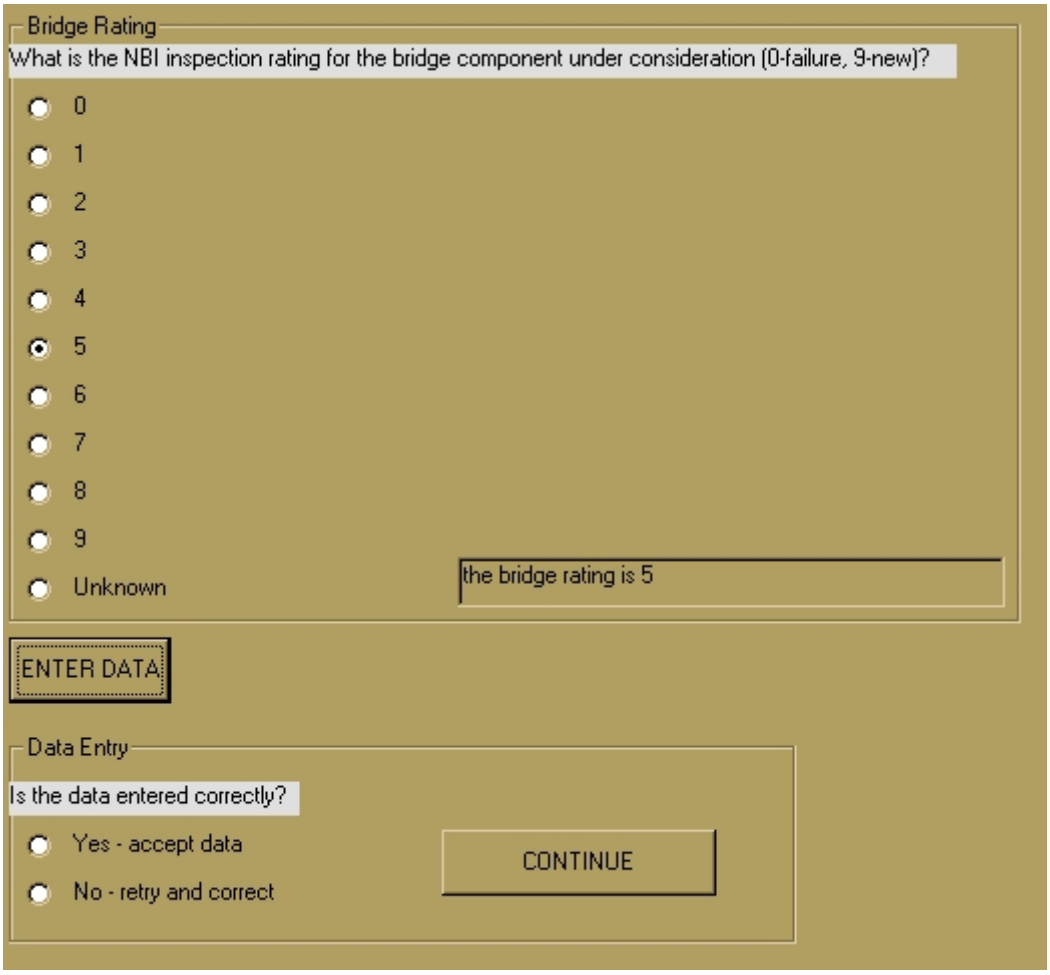
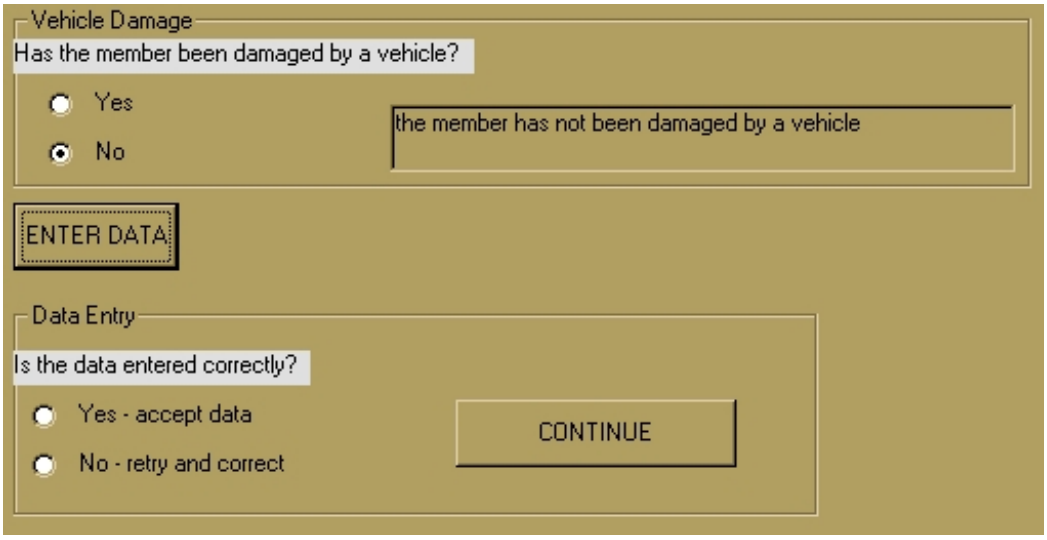
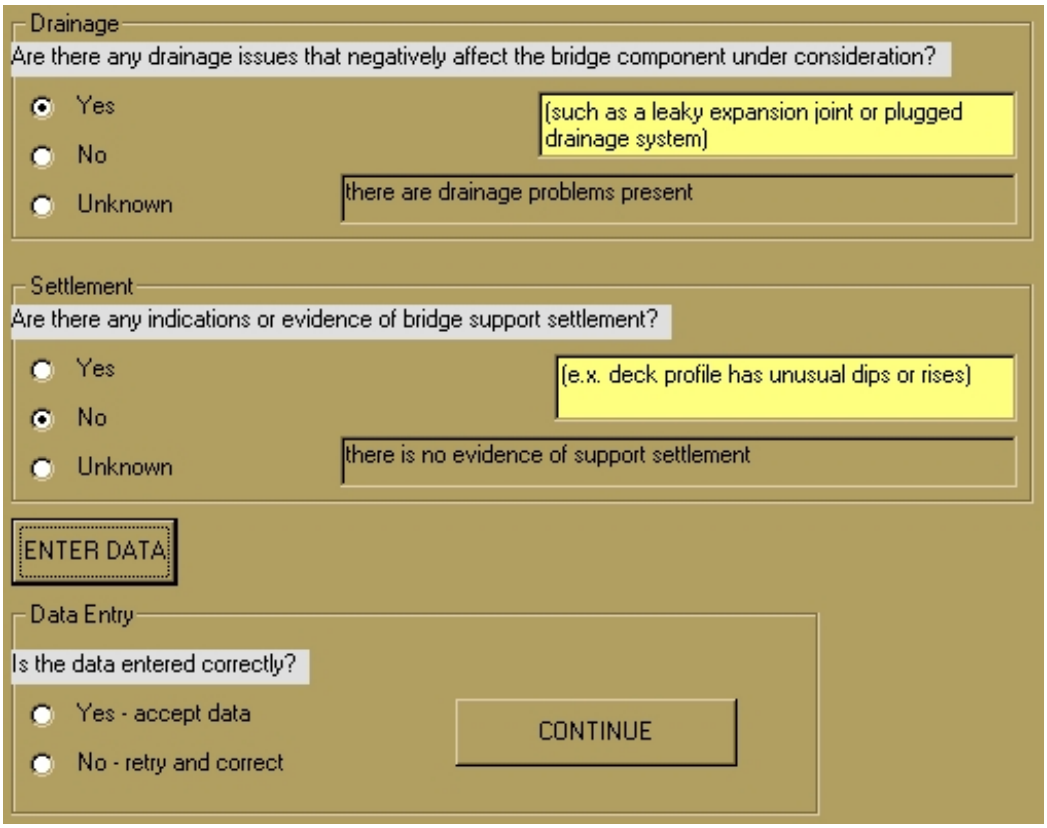

Bridge Type
This bridge is located on:
An interstate highway
A state highway
A county road
A city street
the bridge carries a state highway
Spans Over
This bridge spans over:
A creek
A river
A lake
A city street
A county road
A state highway
An interstate highway
the bridge spans over a state highway
ENTER DATA
Data Entry
Is the data entered correctly?
Yes - accept data
No - retry and correct
CONTINUE

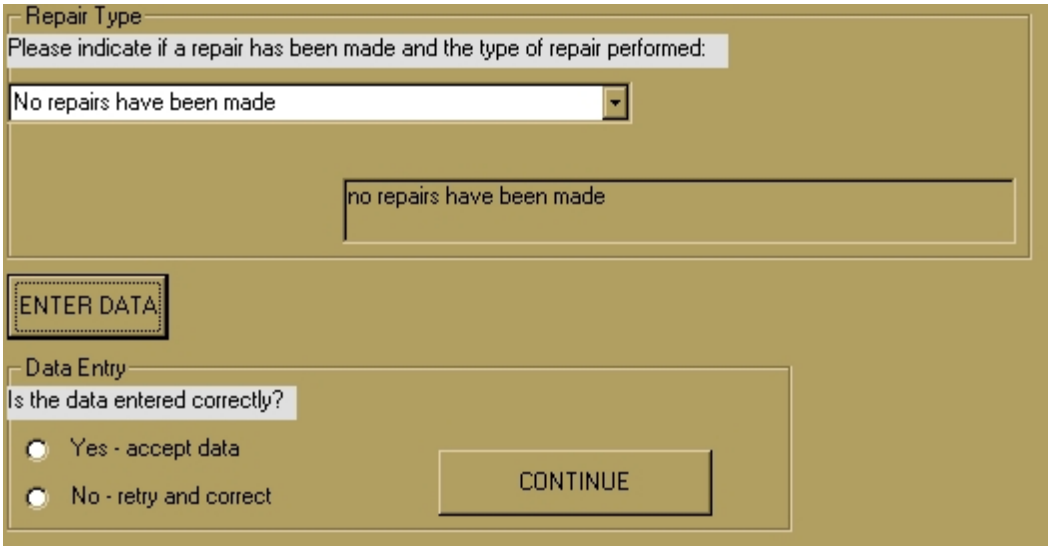

ADT
What is the average daily traffic (ADT) present on the bridge?
ADT < or = 1000
1000 < ADT < or = 10,000
ADT > 10,000
the ADT is greater than 10,000
Truck Traffic
Does this bridge carry a large number of heavily loaded trucks?
Yes
No
Unknown
the bridge carries heavily loaded trucks
ENTER DATA
Data Entry
Is the data entered correctly?
Yes - accept data
No - retry and correct
CONTINUE


Weight Limits
Is this bridge posted for weight limits?
Yes
No
Unknown
the bridge is not posted for weight limits
Structurally Deficient
Is this bridge offically classified as structurally deficient?
Yes
No
Unknown
According to the National Bridge Inventory, structurally deficient refers to inadequate structural sufficientcy or waterway adequacy. The Condition Ratings for the deck, superstructure and substructure is considered to be in "poor condidition". The Structural Evaluation is considered "untolerable" and the waterway and Waterway Adequacy is considereded intolerable, requireing a high priorty for replacement.
the bridge is not classified as structurally deficient
Functionally Obsolete
Is this bridge offically classified as functionally obsolete?
Yes
No
Unknown
According to the National Bridge Inventory, functionally obsolete is related to insufficient geometric capability of the bridge to carry traffic, including inadequate deck geometry, underclearance, or approach roadway alighnment. Bridges which qualify as Structurally Deficient and Functionally Obsolete are excluded from the Functionally Obsolete category.
the bridge is not classified as functionally obsolete
ENTER DATA
Data Entry
Is the data entered correctly?
Yes - accept data
No - retry and correct
CONTINUE


Bridge Rating
What is the NBI inspection rating for the bridge component under consideration (0-failure, 9-new)?
0
1
2
3
4
5
6
7
8
9
Unknown
the bridge rating is 5
ENTER DATA
Data Entry
Is the data entered correctly?
Yes - accept data
No - retry and correct
CONTINUE


Vehicle Damage
Has the member been damaged by a vehicle?
Yes
No
the member has not been damaged by a vehicle
ENTER DATA
Data Entry
Is the data entered correctly?
Yes - accept data
No - retry and correct
CONTINUE


Drainage
Are there any drainage issues that negatively affect the bridge component under consideration?
Yes
No
Unknown
(such as a leaky expansion joint or plugged drainage system)
there are drainage problems present
Settlement
Are there any indications or evidence of bridge support settlement?
Yes
No
Unknown
(e.x. deck profile has unusual dips or rises)
there is no evidence of support settlement
ENTER DATA
Data Entry
Is the data entered correctly?
Yes - accept data
No - retry and correct
CONTINUE


Repair Type
Please indicate if a repair has been made and the type of repair performed:
No repairs have been made
no repairs have been made
ENTER DATA
Data Entry
Is the data entered correctly?
Yes - accept data
No - retry and correct
CONTINUE

Cracking

How would you characterize the extent of cracking, if any, in the member under investigation?

- (•) Extensive
- ( ) Moderate
- ( ) Light
- ( ) Non-existent
- ( ) Unknown

the member is extensively cracked

ENTER DATA

Data Entry

Is the data entered correctly?

- ( ) Yes - accept data
- ( ) No - retry and correct

CONTINUE

Flexural Cracks

Is the cracking observed structural/flexural cracks?

- ( ) Yes
- (•) No
- ( ) Unknown

the cracking is not structural/flexural

Shear Cracks

Is the cracking observed structural/shear cracks?

- ( ) Yes
- (•) No
- ( ) Unknown

the cracking is not structural/shear

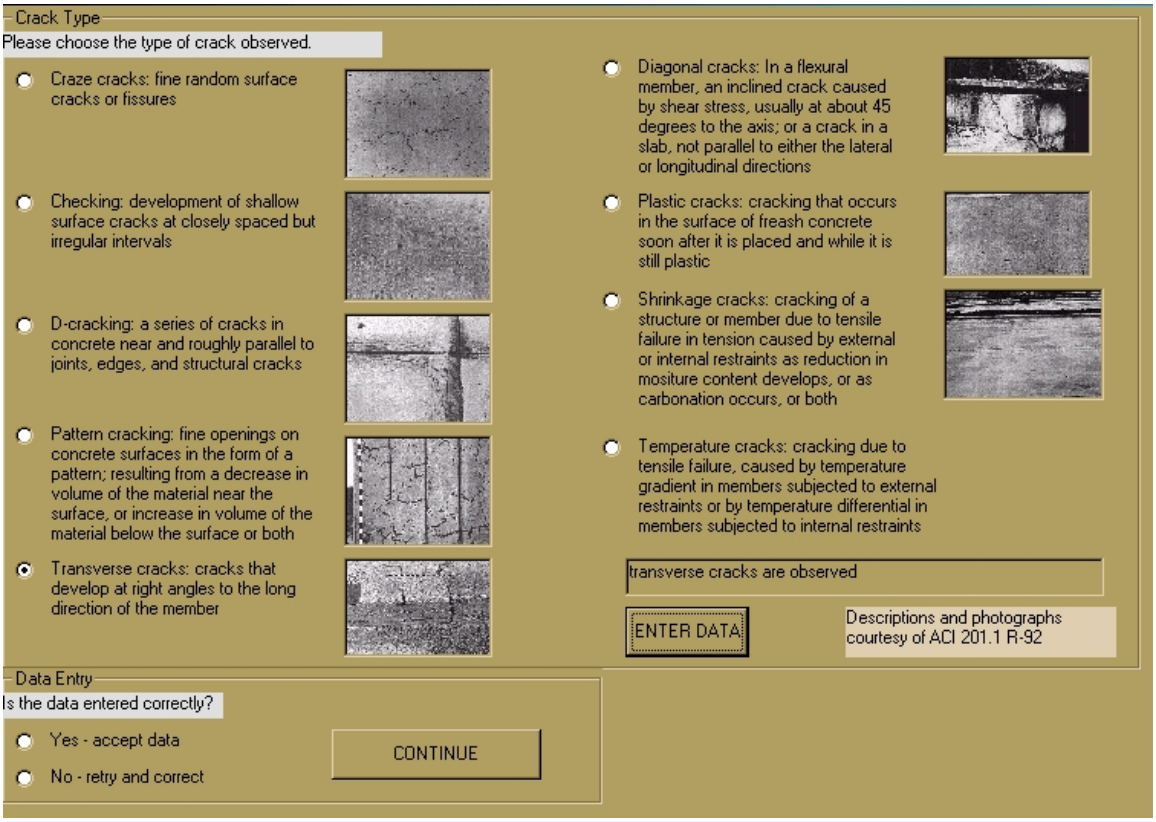
ENTER DATA

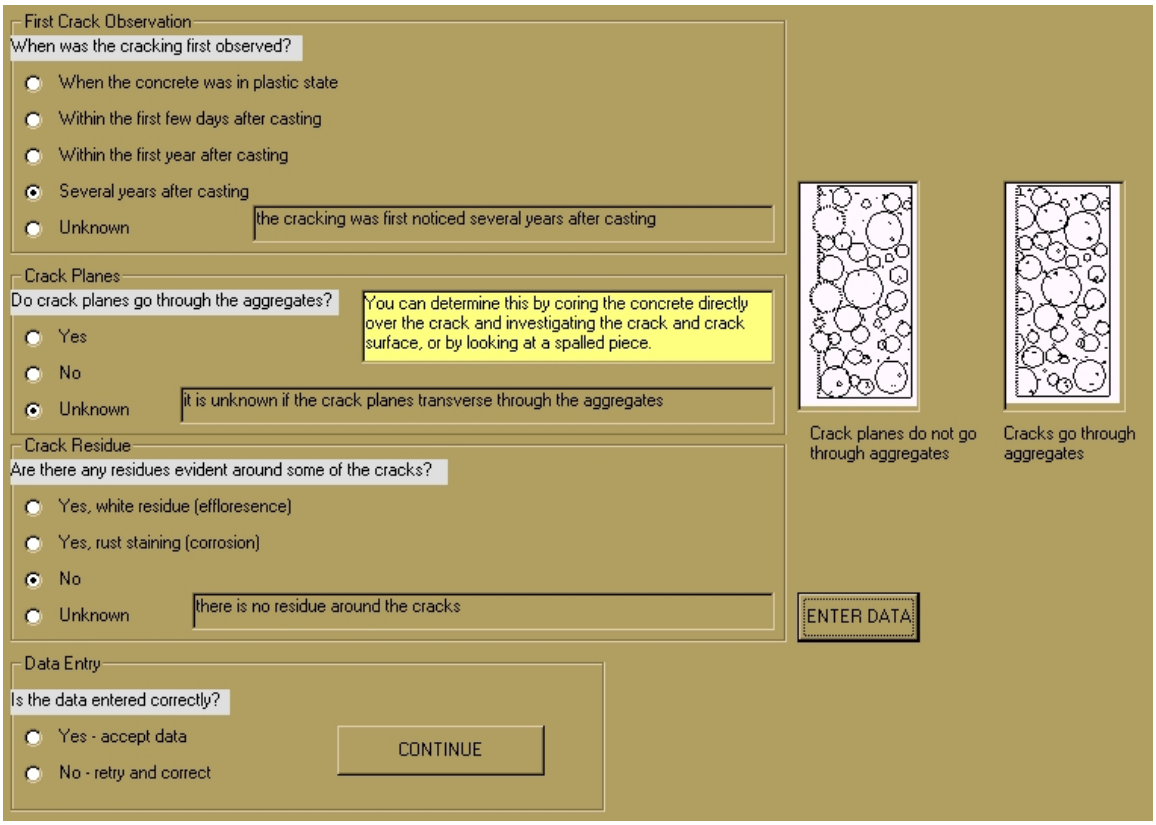
Data Entry

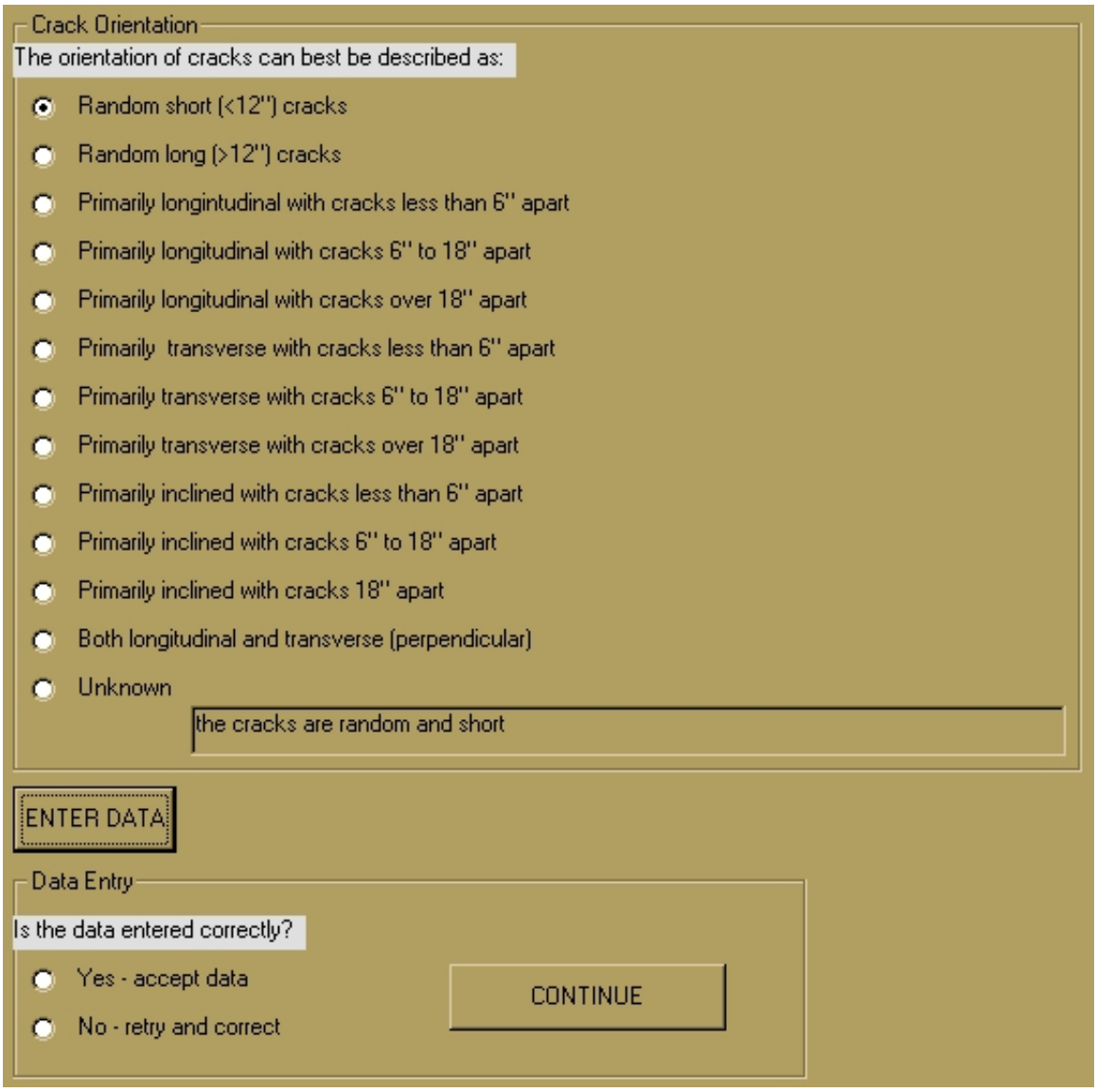
Is the data entered correctly?

- ( ) Yes - accept data
- ( ) No - retry and correct

CONTINUE


Crack Type
Please choose the type of crack observed.
Craze cracks: fine random surface cracks or fissures
Checking: development of shallow surface cracks at closely spaced but irregular intervals
D-cracking: a series of cracks in concrete near and roughly parallel to joints, edges, and structural cracks
Pattern cracking: fine openings on concrete surfaces in the form of a pattern; resulting from a decrease in volume of the material near the surface, or increase in volume of the material below the surface or both
Transverse cracks: cracks that develop at right angles to the long direction of the member
Diagonal cracks: In a flexural member, an inclined crack caused by shear stress, usually at about 45 degrees to the axis; or a crack in a slab, not parallel to either the lateral or longitudinal directions
Plastic cracks: cracking that occurs in the surface of freash concrete soon after it is placed and while it is still plastic
Shrinkage cracks: cracking of a structure or member due to tensile failure in tension caused by external or internal restraints as reduction in mositure content develops, or as carbonation occurs, or both
Temperature cracks: cracking due to tensile failure, caused by temperature gradient in members subjected to external restraints or by temperature differential in members subjected to internal restraints
transverse cracks are observed
ENTER DATA
Descriptions and photographs courtesy of ACI 201.1 R-92
Data Entry
Is the data entered correctly?
Yes - accept data
No - retry and correct
CONTINUE


First Crack Observation
When was the cracking first observed?
When the concrete was in plastic state
Within the first few days after casting
Within the first year after casting
Several years after casting
Unknown
the cracking was first noticed several years after casting
Crack Planes
Do crack planes go through the aggregates?
You can determine this by coring the concrete directly over the crack and investigating the crack and crack surface, or by looking at a spalled piece.
Yes
No
Unknown
it is unknown if the crack planes transverse through the aggregates
Crack Residue
Are there any residues evident around some of the cracks?
Yes, white residue (effloresence)
Yes, rust staining (corrosion)
No
Unknown
there is no residue around the cracks
Crack planes do not go through aggregates
Cracks go through aggregates
ENTER DATA
Data Entry
Is the data entered correctly?
Yes - accept data
No - retry and correct
CONTINUE


Crack Orientation
The orientation of cracks can best be described as:
Random short (<12") cracks
Random long (>12") cracks
Primarily longintudinal with cracks less than 6" apart
Primarily longitudinal with cracks 6" to 18" apart
Primarily longitudinal with cracks over 18" apart
Primarily transverse with cracks less than 6" apart
Primarily transverse with cracks 6" to 18" apart
Primarily transverse with cracks over 18" apart
Primarily inclined with cracks less than 6" apart
Primarily inclined with cracks 6" to 18" apart
Primarily inclined with cracks 18" apart
Both longitudinal and transverse (perpendicular)
Unknown
the cracks are random and short
ENTER DATA
Data Entry
Is the data entered correctly?
Yes - accept data
No - retry and correct
CONTINUE

Loading

Is the cracking related to extraordinary loading?

- Yes
- No
- Unknown

the cracking is not related to extraordinary loading

Crack Movement

Do crack widths change as temperature changes occur?

- Yes
- No
- Unknown

A crack gage can be placed across the crack to measure movements.

the crack widths do not change with temperature changes

ENTER DATA

Data Entry

Is the data entered correctly?

- Yes - accept data
- No - retry and correct

CONTINUE

Blistering

Is concrete blistering evident?

- Yes
- No

Blistering: the irregular raising of a thin layer, frequently 25 to 300 mm in diameter, at the surface of placed mortar or concrete during or soon after completition of the finishing operation; blistering is usually attributed to early closing of the surface and may be aggravated by cool temperatures.

concrete blistering is not evident

Honeycomb

Is honeycombing evident?

- Yes
- No

Honeycomb: voids left in concrete due to failure of the mortar to effectively fill the spaces among course aggregate particles.

concrete honeycombing is not evident

Abrasion

Is abrasion damage evident?

- Yes
- No

Abrasion Damage: wearing away of a surface by rubbing and friction

concrete abrasion damage is not evident

ENTER DATA

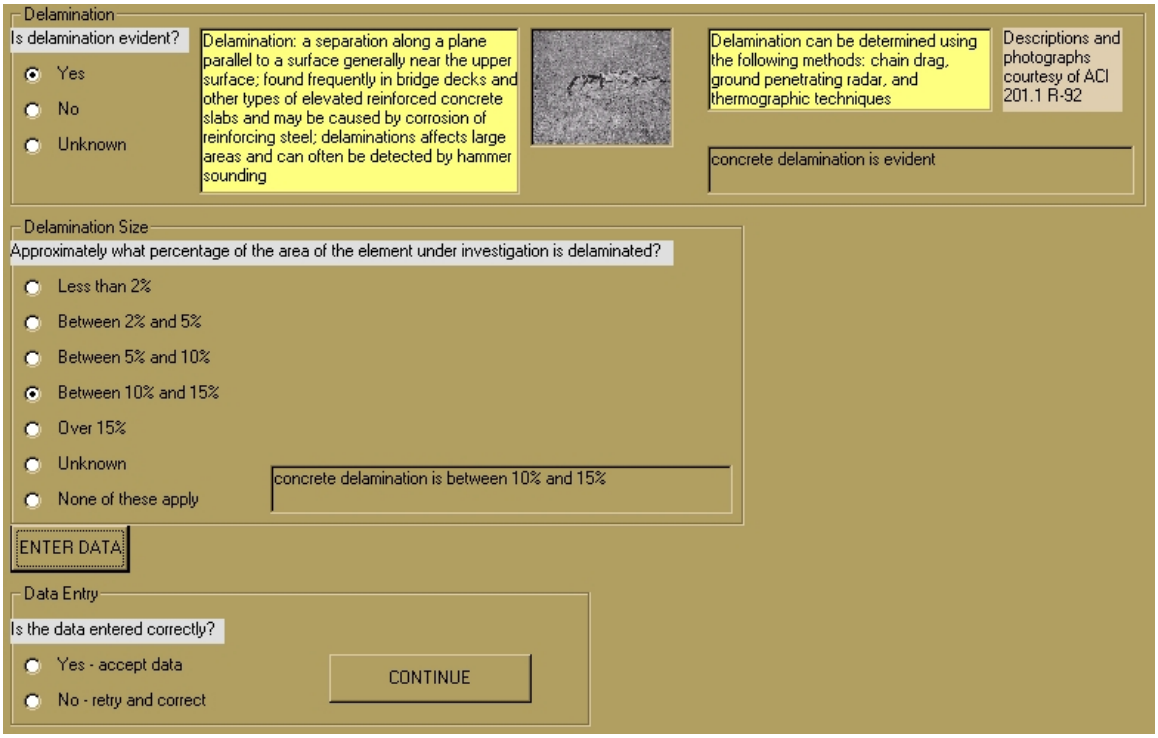
Descriptions and photographs courtesy of ACI 201.1 R-92

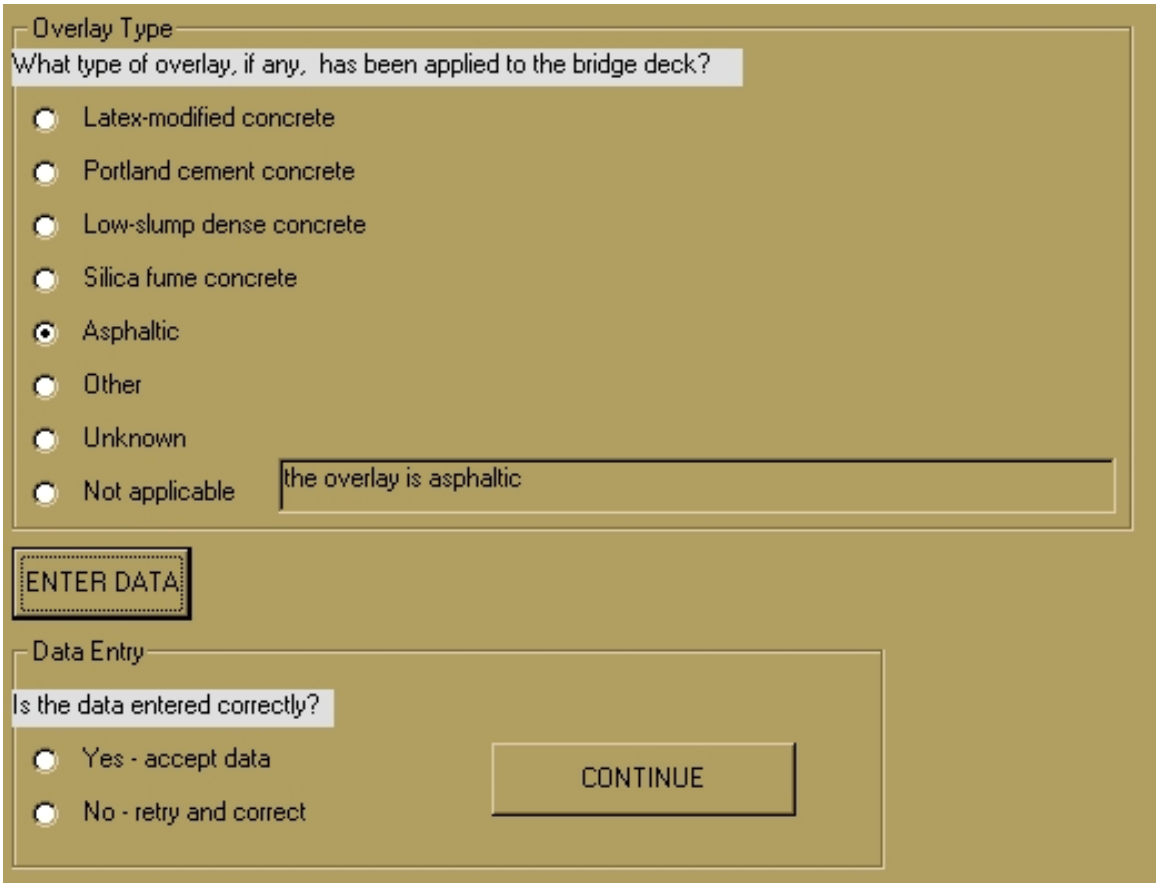
Data Entry

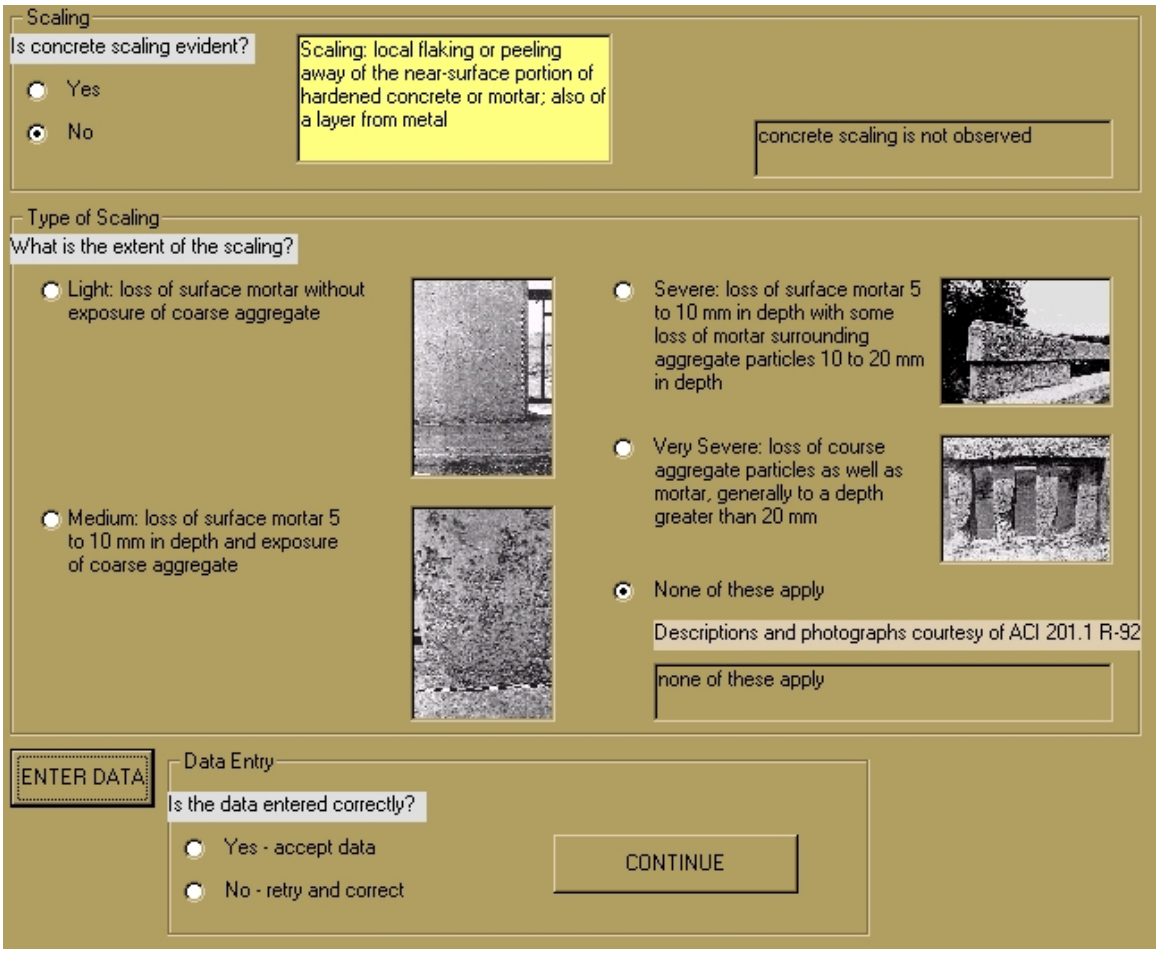
Is the data entered correctly?

- Yes - accept data
- No - retry and correct

CONTINUE


Delamination
Is delamination evident?
Yes
No
Unknown
Delamination: a separation along a plane parallel to a surface generally near the upper surface; found frequently in bridge decks and other types of elevated reinforced concrete slabs and may be caused by corrosion of reinforcing steel; delaminations affects large areas and can often be detected by hammer sounding
Delamination can be determined using the following methods: chain drag, ground penetrating radar, and thermographic techniques
Descriptions and photographs courtesy of ACI 201.1 R-92
concrete delamination is evident
Delamination Size
Approximately what percentage of the area of the element under investigation is delaminated?
Less than 2%
Between 2% and 5%
Between 5% and 10%
Between 10% and 15%
Over 15%
Unknown
None of these apply
concrete delamination is between 10% and 15%
ENTER DATA
Data Entry
Is the data entered correctly?
Yes - accept data
No - retry and correct
CONTINUE


Overlay Type
What type of overlay, if any, has been applied to the bridge deck?
Latex-modified concrete
Portland cement concrete
Low-slump dense concrete
Silica fume concrete
Asphaltic
Other
Unknown
Not applicable
the overlay is asphaltic
ENTER DATA
Data Entry
Is the data entered correctly?
Yes - accept data
No - retry and correct
CONTINUE


Scaling
Is concrete scaling evident?
Yes
No
Scaling: local flaking or peeling away of the near-surface portion of hardened concrete or mortar; also of a layer from metal
concrete scaling is not observed
Type of Scaling
What is the extent of the scaling?
Light: loss of surface mortar without exposure of coarse aggregate
Medium: loss of surface mortar 5 to 10 mm in depth and exposure of coarse aggregate
Severe: loss of surface mortar 5 to 10 mm in depth with some loss of mortar surrounding aggregate particles 10 to 20 mm in depth
Very Severe: loss of course aggregate particles as well as mortar, generally to a depth greater than 20 mm
None of these apply
Descriptions and photographs courtesy of ACI 201.1 R-92
none of these apply
ENTER DATA
Data Entry
Is the data entered correctly?
Yes - accept data
No - retry and correct
CONTINUE

Popouts

Are concrete popouts evident?

Popout: the breaking away of small portions of a concrete surface due to localized internal pressure which leaves a shallow, typically conical, depression

- ○ Yes
- ◉ No

popouts are not observed

Popout Size

What is the size of the popout?

- ○ Small: popouts leaving holes up to 10 mm in diameter, or the equivalent

- ○ Large: popouts leaving holes greater than 50 mm in diameter, or the eqivalent

- ◉ None of these apply
- ○ Medium: popouts leaving holes between 10 and 50 mm in diameter, or the equivalent

none of these apply

Descriptions and photographs courtesy of ACI 201.1 R-92

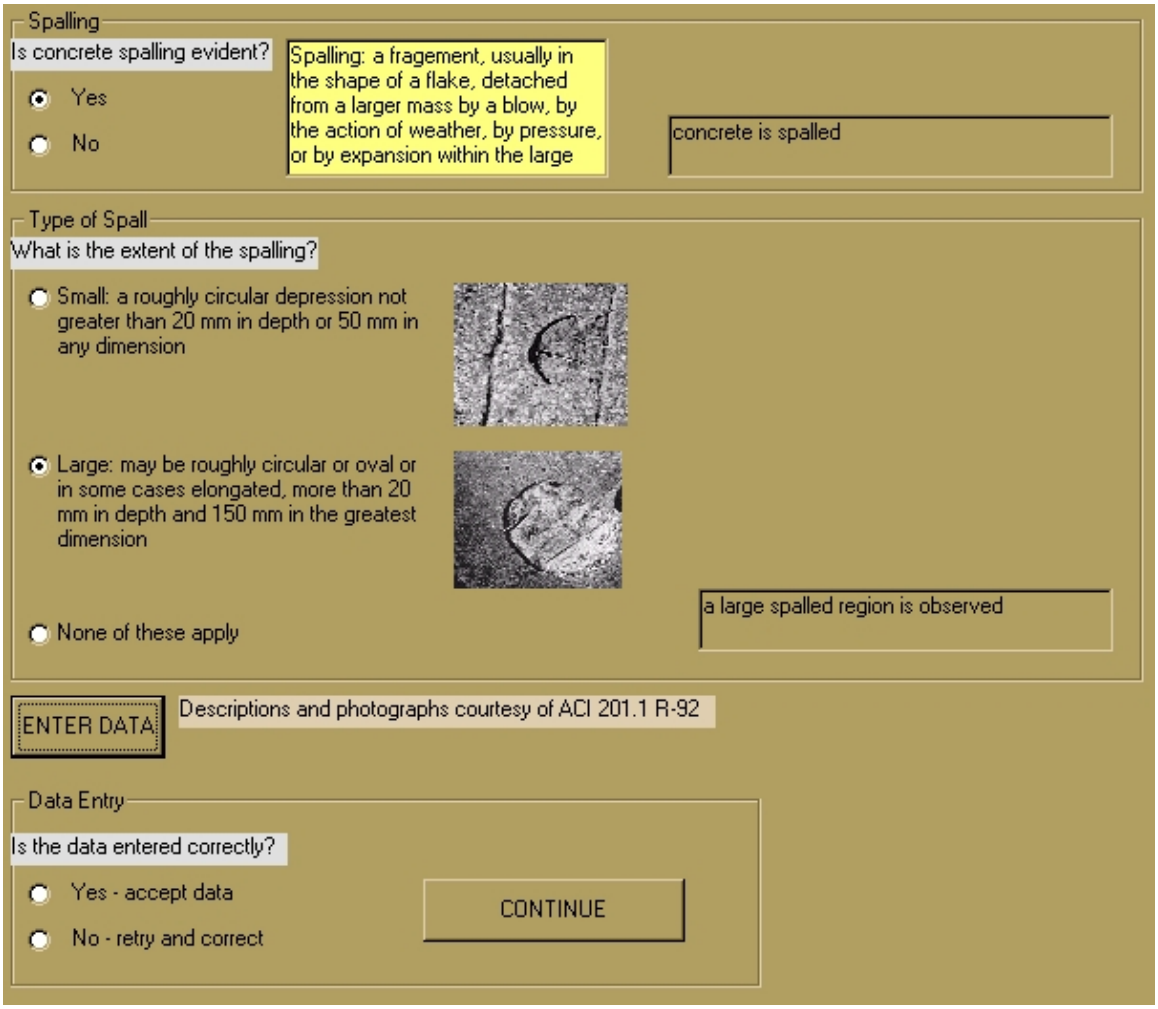
ENTER DATA

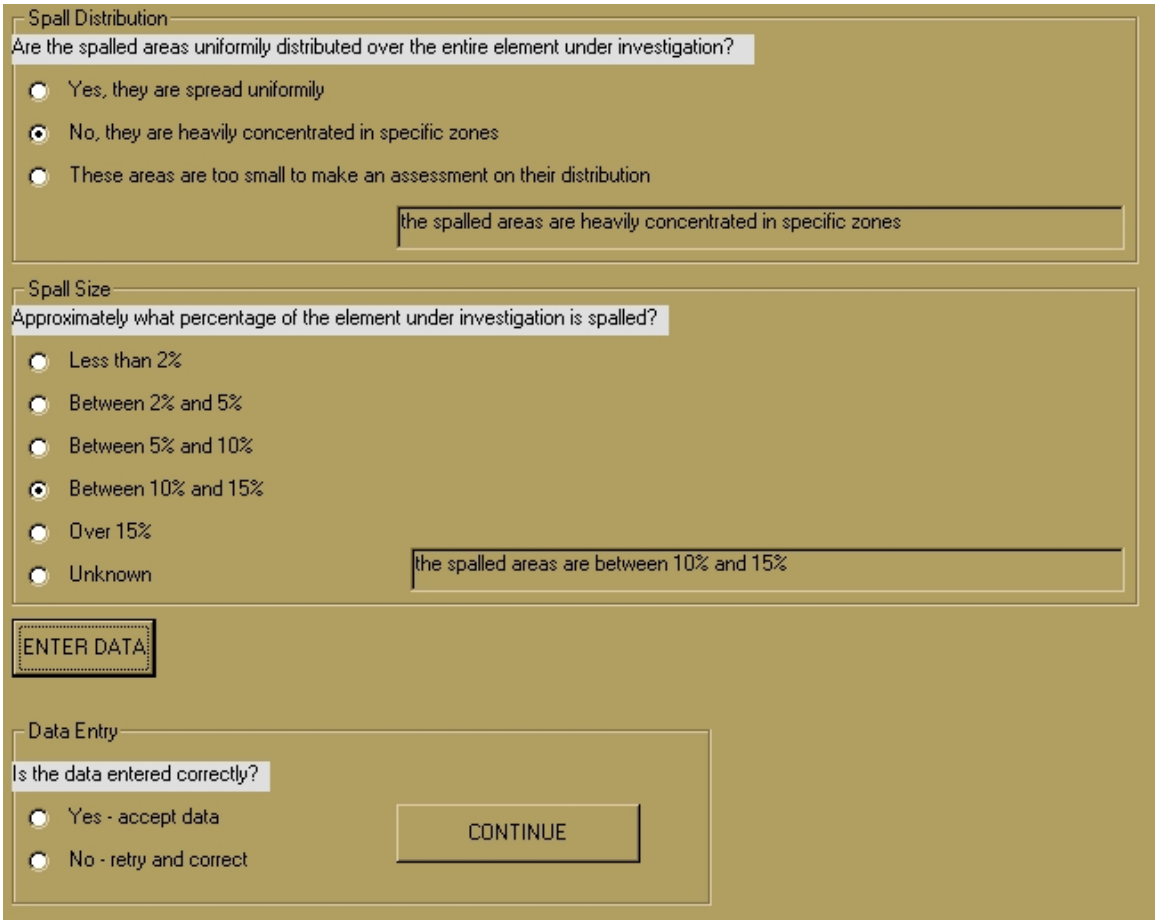
Data Entry

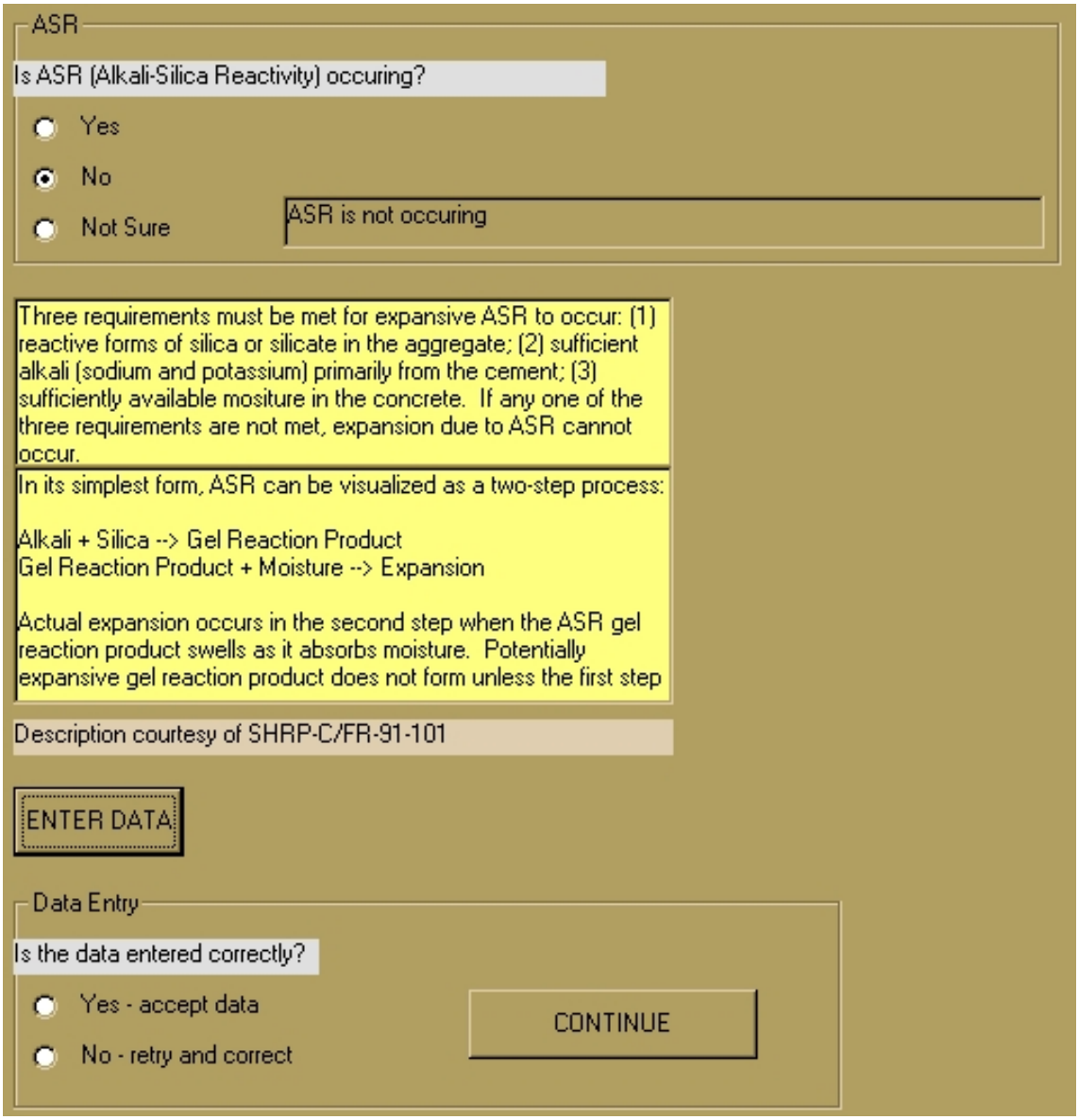
Is the data entered correctly?

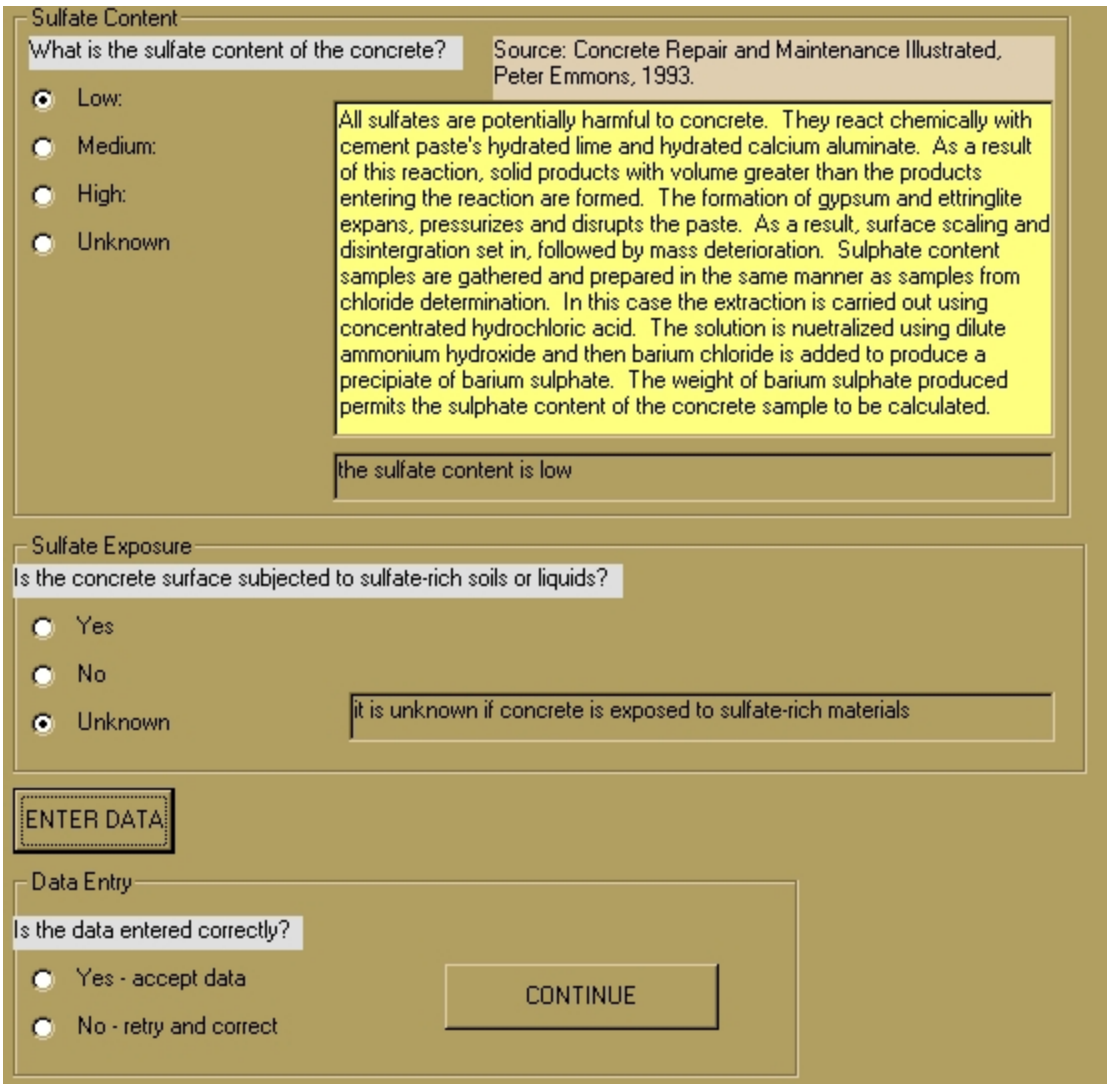
- ○ Yes - accept data
- ○ No - retry and correct

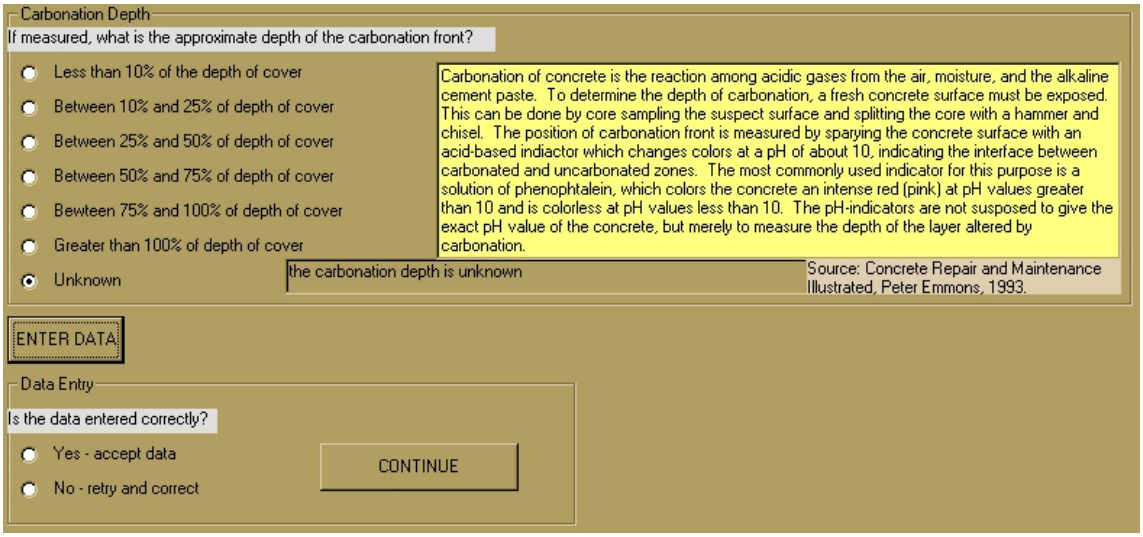
CONTINUE

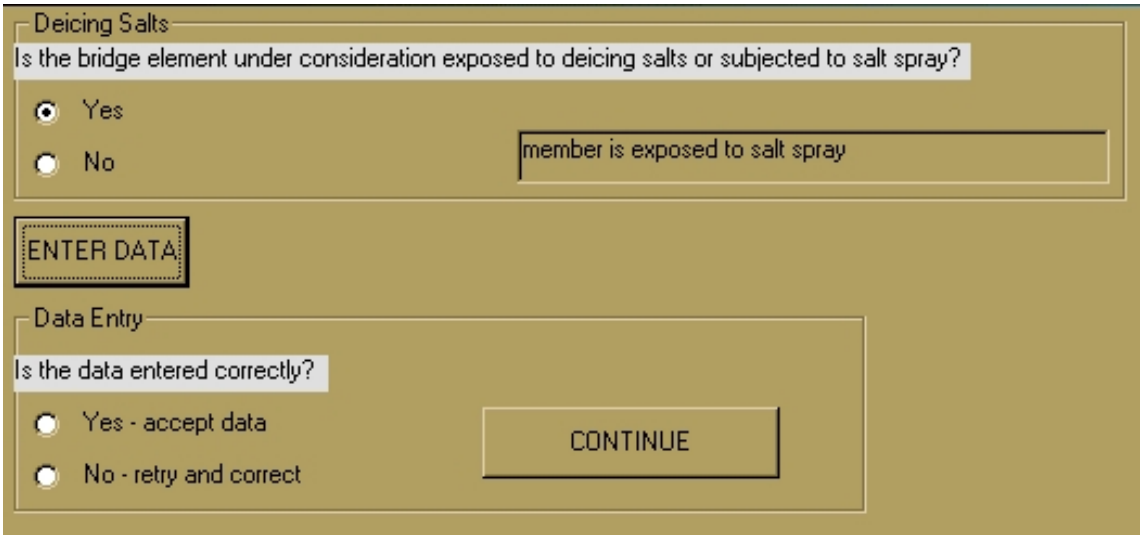

Spalling
Is concrete spalling evident?
Yes
No
Spalling: a fragement, usually in the shape of a flake, detached from a larger mass by a blow, by the action of weather, by pressure, or by expansion within the large
concrete is spalled
Type of Spall
What is the extent of the spalling?
Small: a roughly circular depression not greater than 20 mm in depth or 50 mm in any dimension
Large: may be roughly circular or oval or in some cases elongated, more than 20 mm in depth and 150 mm in the greatest dimension
None of these apply
a large spalled region is observed
ENTER DATA
Descriptions and photographs courtesy of ACI 201.1 R-92
Data Entry
Is the data entered correctly?
Yes - accept data
No - retry and correct
CONTINUE

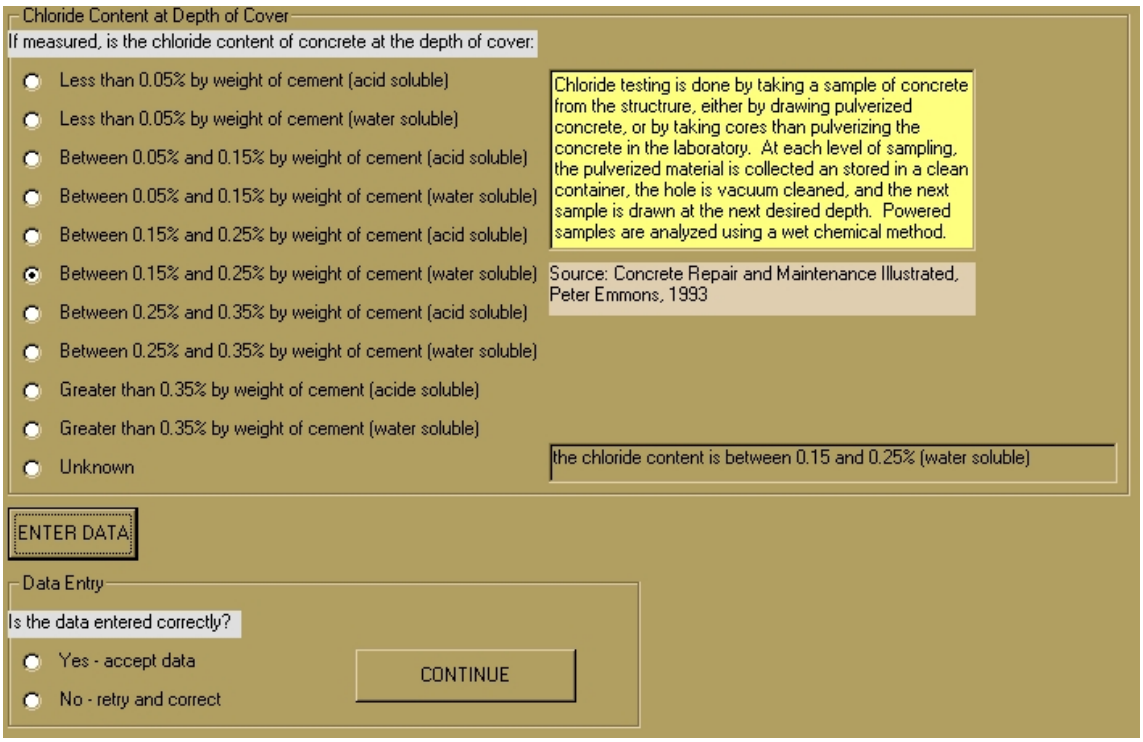

Spall Distribution
Are the spalled areas uniformly distributed over the entire element under investigation?
Yes, they are spread uniformly
No, they are heavily concentrated in specific zones
These areas are too small to make an assessment on their distribution
the spalled areas are heavily concentrated in specific zones
Spall Size
Approximately what percentage of the element under investigation is spalled?
Less than 2%
Between 2% and 5%
Between 5% and 10%
Between 10% and 15%
Over 15%
Unknown
the spalled areas are between 10% and 15%
ENTER DATA
Data Entry
Is the data entered correctly?
Yes - accept data
No - retry and correct
CONTINUE

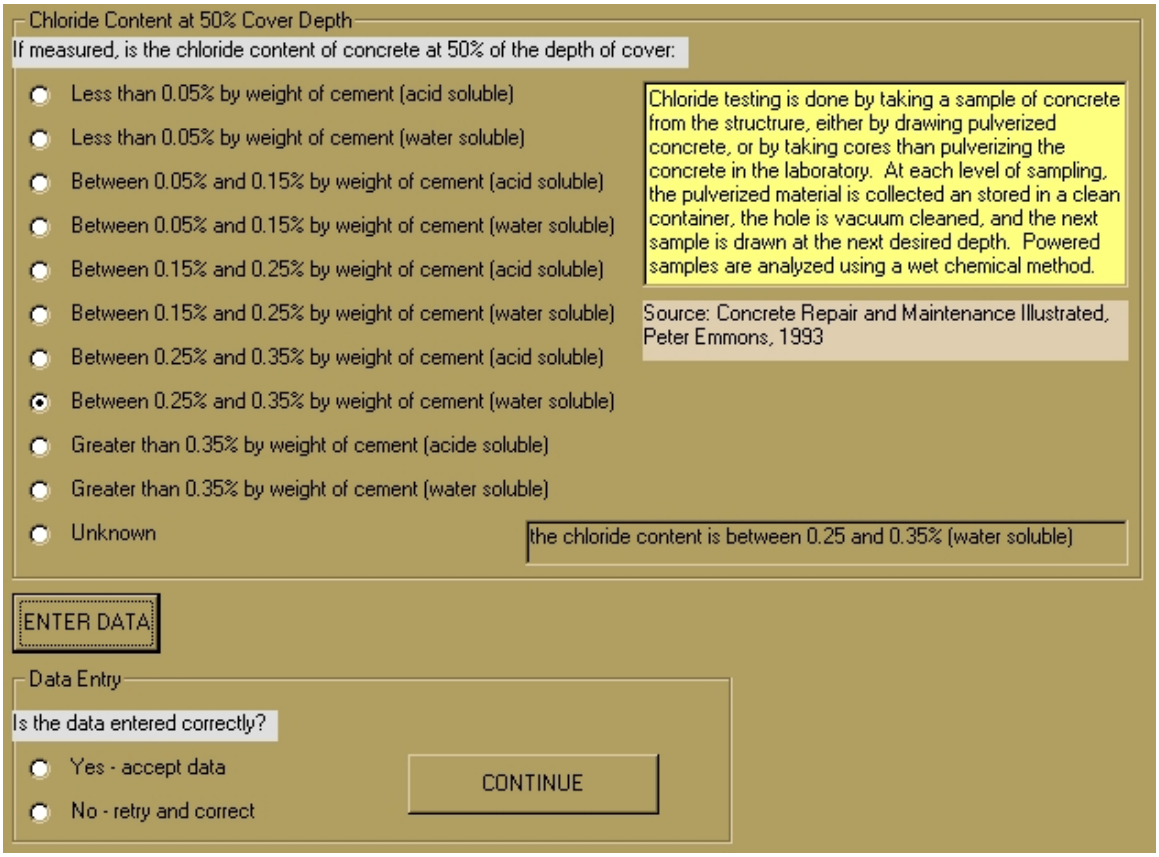

ASR
Is ASR (Alkali-Silica Reactivity) occuring?
Yes
No
Not Sure
ASR is not occuring
Three requirements must be met for expansive ASR to occur: (1) reactive forms of silica or silicate in the aggregate; (2) sufficient alkali (sodium and potassium) primarily from the cement; (3) sufficiently available mositure in the concrete. If any one of the three requirements are not met, expansion due to ASR cannot occur.
In its simplest form, ASR can be visualized as a two-step process:
Alkali + Silica --> Gel Reaction Product
Gel Reaction Product + Moisture --> Expansion
Actual expansion occurs in the second step when the ASR gel reaction product swells as it absorbs moisture. Potentially expansive gel reaction product does not form unless the first step
Description courtesy of SHRP-C/FR-91-101
ENTER DATA
Data Entry
Is the data entered correctly?
Yes - accept data
No - retry and correct
CONTINUE

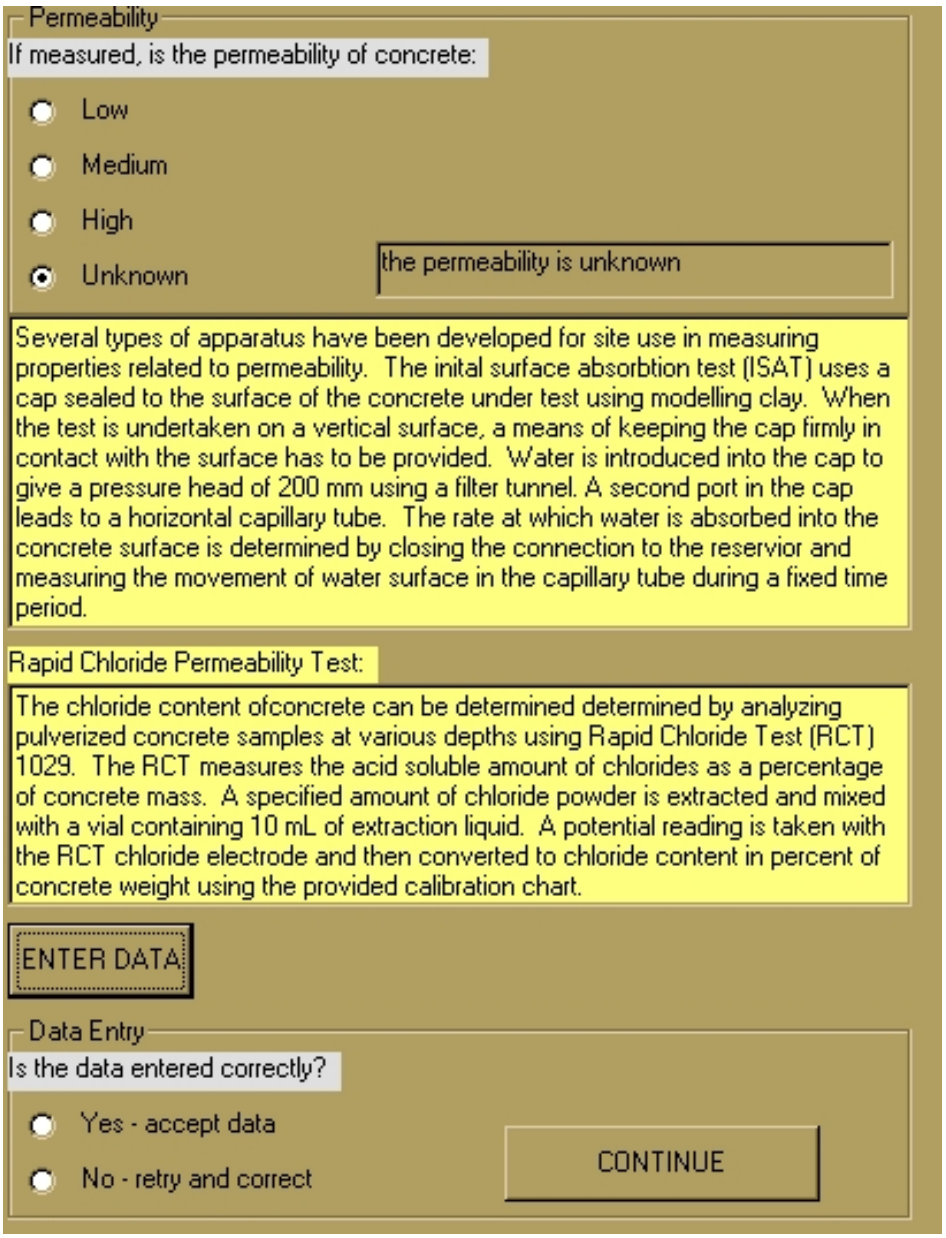

Sulfate Content
What is the sulfate content of the concrete?
Source: Concrete Repair and Maintenance Illustrated, Peter Emmons, 1993.
Low:
Medium:
High:
Unknown
All sulfates are potentially harmful to concrete. They react chemically with cement paste's hydrated lime and hydrated calcium aluminate. As a result of this reaction, solid products with volume greater than the products entering the reaction are formed. The formation of gypsum and ettringlite expans, pressurizes and disrupts the paste. As a result, surface scaling and disintergration set in, followed by mass deterioration. Sulphate content samples are gathered and prepared in the same manner as samples from chloride determination. In this case the extraction is carried out using concentrated hydrochloric acid. The solution is nuetralized using dilute ammonium hydroxide and then barium chloride is added to produce a precipiate of barium sulphate. The weight of barium sulphate produced permits the sulphate content of the concrete sample to be calculated.
the sulfate content is low
Sulfate Exposure
Is the concrete surface subjected to sulfate-rich soils or liquids?
Yes
No
Unknown
it is unknown if concrete is exposed to sulfate-rich materials
ENTER DATA
Data Entry
Is the data entered correctly?
Yes - accept data
No - retry and correct
CONTINUE

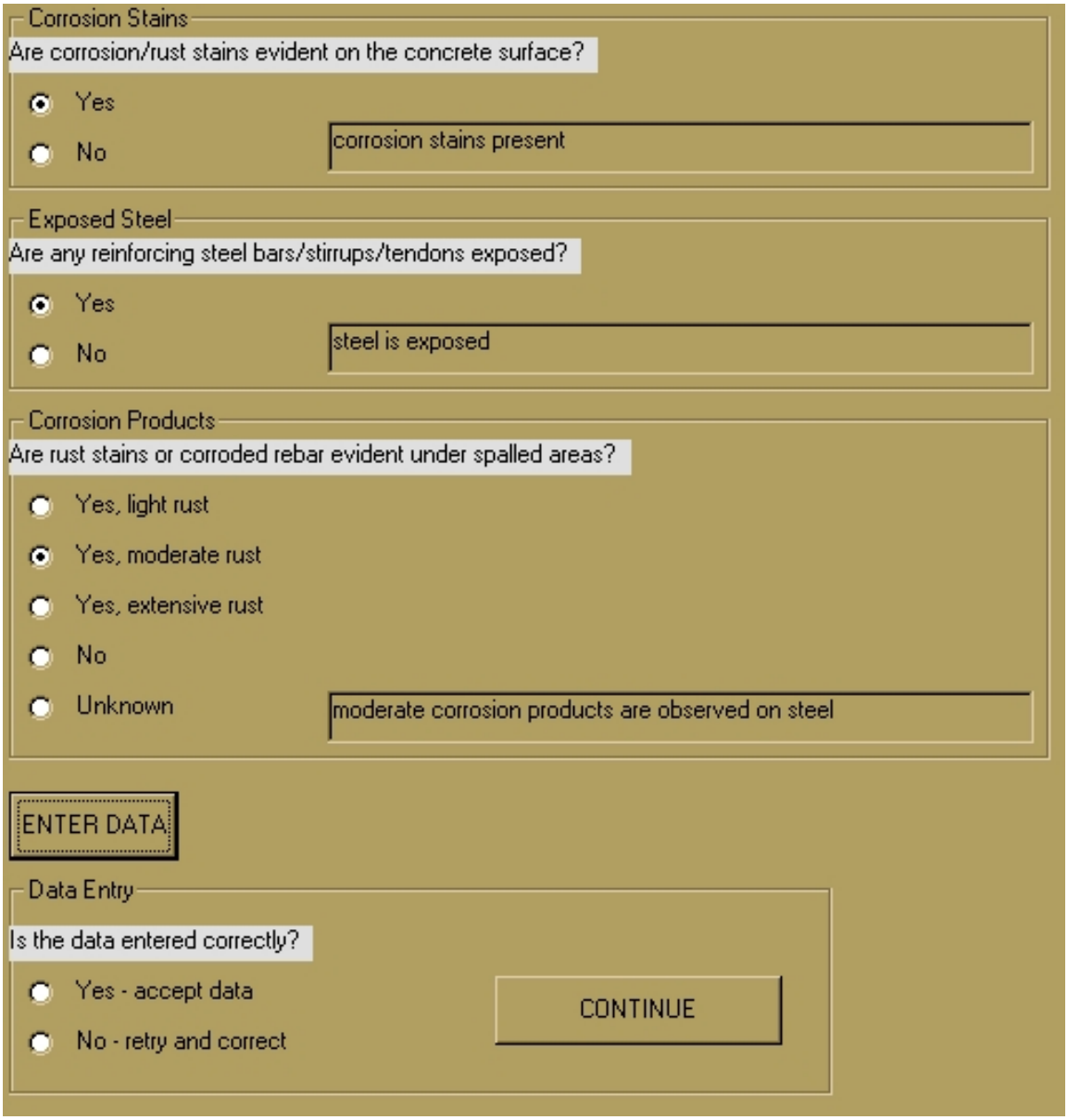

Carbonation Depth
If measured, what is the approximate depth of the carbonation front?
Less than 10% of the depth of cover
Between 10% and 25% of depth of cover
Between 25% and 50% of depth of cover
Between 50% and 75% of depth of cover
Bewteen 75% and 100% of depth of cover
Greater than 100% of depth of cover
Unknown
Carbonation of concrete is the reaction among acidic gases from the air, moisture, and the alkaline cement paste. To determine the depth of carbonation, a fresh concrete surface must be exposed. This can be done by core sampling the suspect surface and splitting the core with a hammer and chisel. The position of carbonation front is measured by sparying the concrete surface with an acid-based indiactor which changes colors at a pH of about 10, indicating the interface between carbonated and uncarbonated zones. The most commonly used indicator for this purpose is a solution of phenophtalein, which colors the concrete an intense red (pink) at pH values greater than 10 and is colorless at pH values less than 10. The pH-indicators are not susposed to give the exact pH value of the concrete, but merely to measure the depth of the layer altered by carbonation.
the carbonation depth is unknown
Source: Concrete Repair and Maintenance Illustrated, Peter Emmons, 1993.
ENTER DATA
Data Entry
Is the data entered correctly?
Yes - accept data
No - retry and correct
CONTINUE

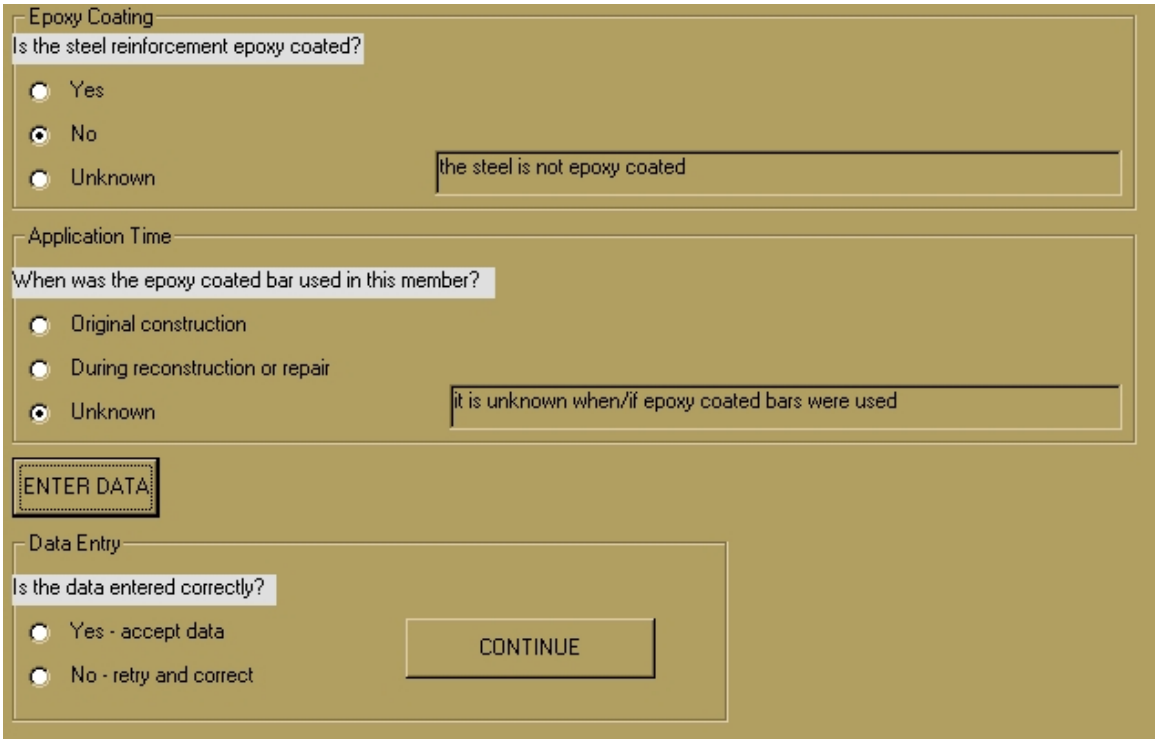

Deicing Salts
Is the bridge element under consideration exposed to deicing salts or subjected to salt spray?
Yes
No
member is exposed to salt spray
ENTER DATA
Data Entry
Is the data entered correctly?
Yes - accept data
No - retry and correct
CONTINUE

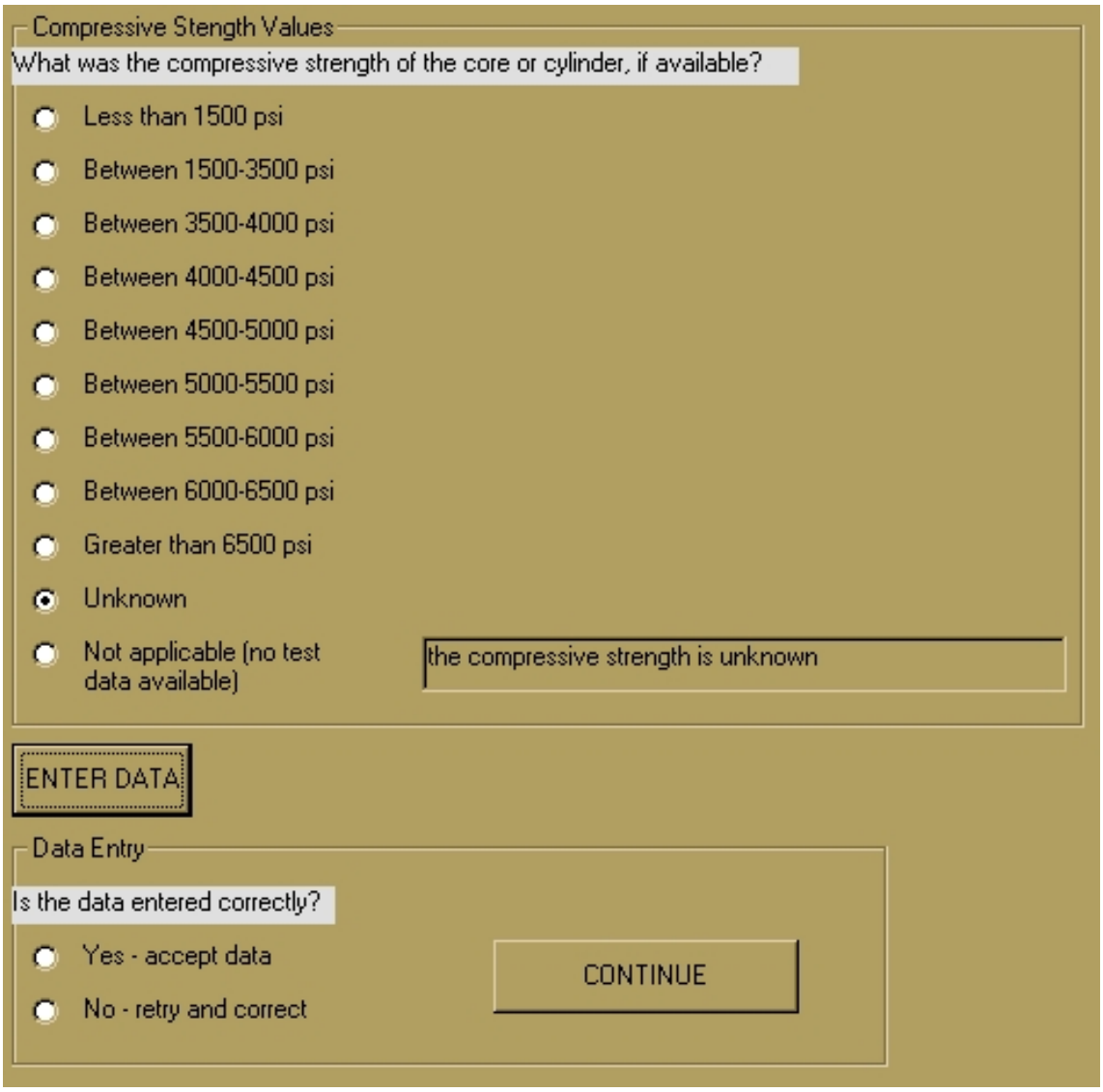

Chloride Content at Depth of Cover
If measured, is the chloride content of concrete at the depth of cover:
Less than 0.05% by weight of cement (acid soluble)
Less than 0.05% by weight of cement (water soluble)
Between 0.05% and 0.15% by weight of cement (acid soluble)
Between 0.05% and 0.15% by weight of cement (water soluble)
Between 0.15% and 0.25% by weight of cement (acid soluble)
Between 0.15% and 0.25% by weight of cement (water soluble)
Between 0.25% and 0.35% by weight of cement (acid soluble)
Between 0.25% and 0.35% by weight of cement (water soluble)
Greater than 0.35% by weight of cement (acide soluble)
Greater than 0.35% by weight of cement (water soluble)
Unknown
Chloride testing is done by taking a sample of concrete from the structrure, either by drawing pulverized concrete, or by taking cores than pulverizing the concrete in the laboratory. At each level of sampling, the pulverized material is collected an stored in a clean container, the hole is vacuum cleaned, and the next sample is drawn at the next desired depth. Powered samples are analyzed using a wet chemical method.
Source: Concrete Repair and Maintenance Illustrated, Peter Emmons, 1993
the chloride content is between 0.15 and 0.25% (water soluble)
ENTER DATA
Data Entry
Is the data entered correctly?
Yes - accept data
No - retry and correct
CONTINUE

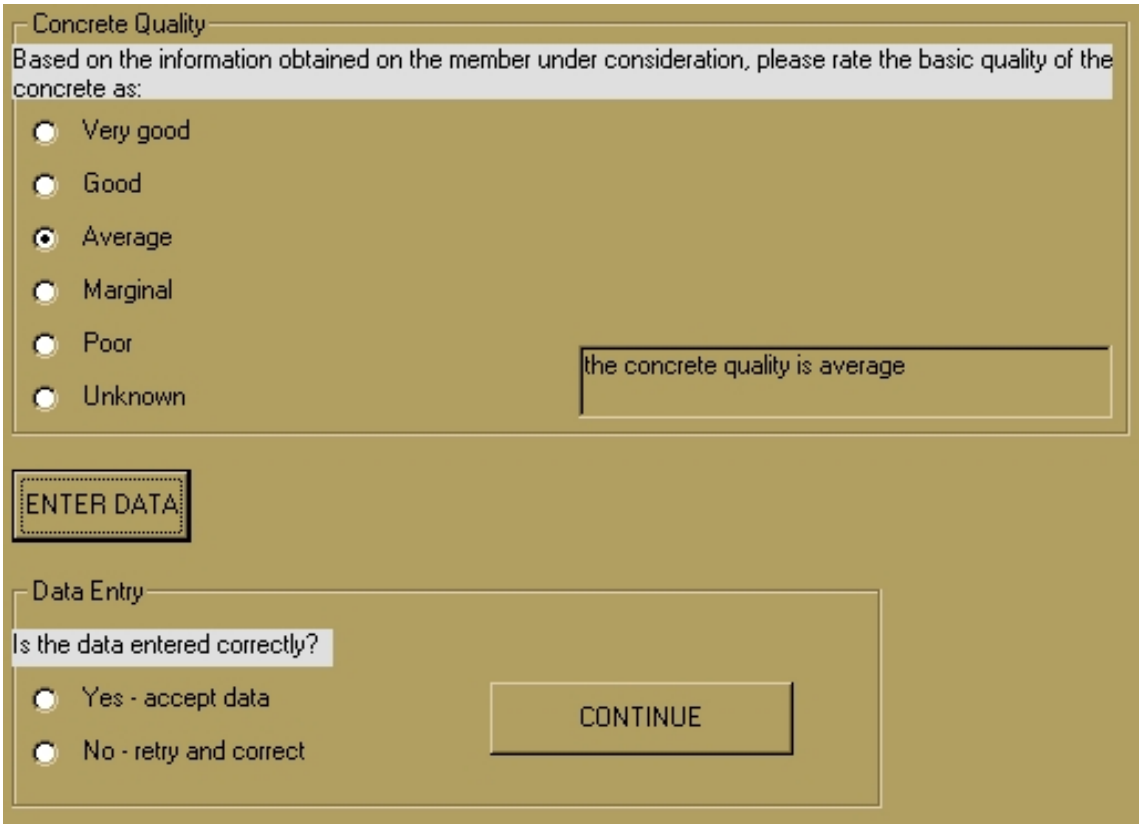

Chloride Content at 50% Cover Depth
If measured, is the chloride content of concrete at 50% of the depth of cover:
Less than 0.05% by weight of cement (acid soluble)
Less than 0.05% by weight of cement (water soluble)
Between 0.05% and 0.15% by weight of cement (acid soluble)
Between 0.05% and 0.15% by weight of cement (water soluble)
Between 0.15% and 0.25% by weight of cement (acid soluble)
Between 0.15% and 0.25% by weight of cement (water soluble)
Between 0.25% and 0.35% by weight of cement (acid soluble)
Between 0.25% and 0.35% by weight of cement (water soluble)
Greater than 0.35% by weight of cement (acide soluble)
Greater than 0.35% by weight of cement (water soluble)
Unknown
Chloride testing is done by taking a sample of concrete from the structrure, either by drawing pulverized concrete, or by taking cores than pulverizing the concrete in the laboratory. At each level of sampling, the pulverized material is collected an stored in a clean container, the hole is vacuum cleaned, and the next sample is drawn at the next desired depth. Powered samples are analyzed using a wet chemical method.
Source: Concrete Repair and Maintenance Illustrated, Peter Emmons, 1993
the chloride content is between 0.25 and 0.35% (water soluble)
ENTER DATA
Data Entry
Is the data entered correctly?
Yes - accept data
No - retry and correct
CONTINUE

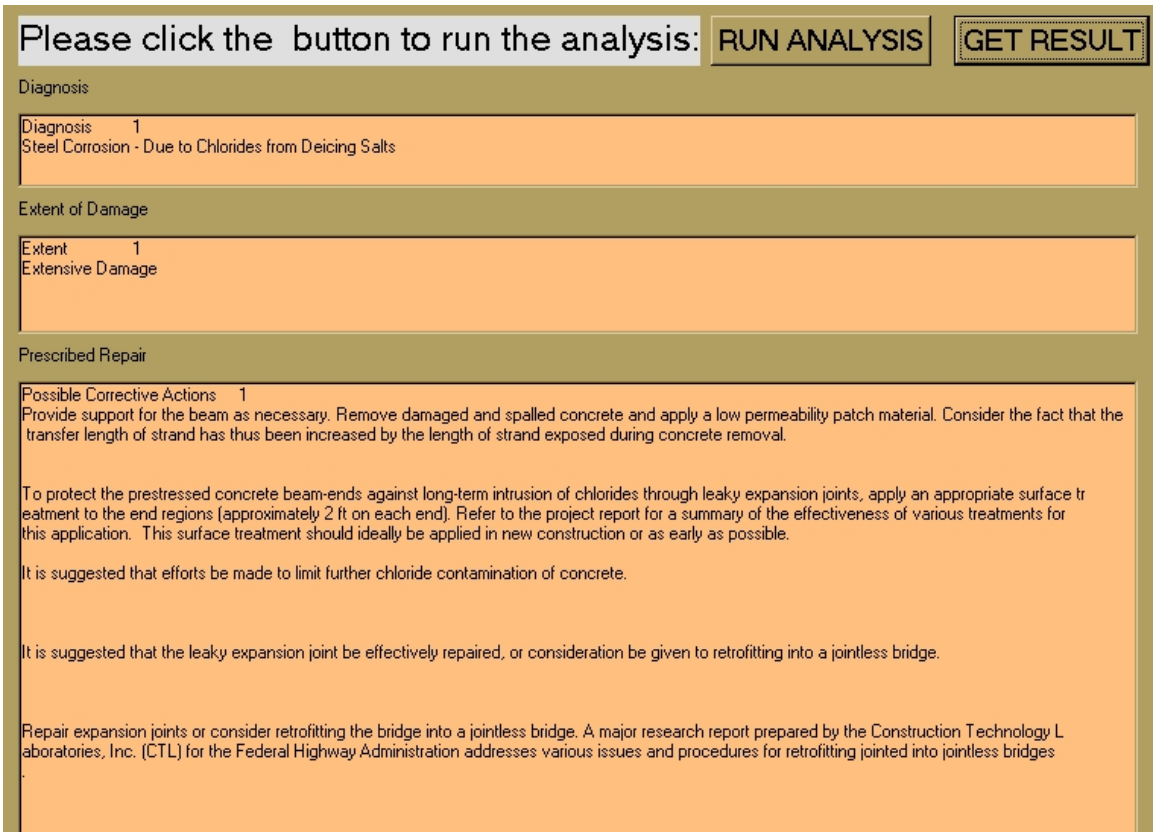

Permeability
If measured, is the permeability of concrete:
Low
Medium
High
Unknown
the permeability is unknown
Several types of apparatus have been developed for site use in measuring properties related to permeability. The inital surface absorbtion test (ISAT) uses a cap sealed to the surface of the concrete under test using modelling clay. When the test is undertaken on a vertical surface, a means of keeping the cap firmly in contact with the surface has to be provided. Water is introduced into the cap to give a pressure head of 200 mm using a filter tunnel. A second port in the cap leads to a horizontal capillary tube. The rate at which water is absorbed into the concrete surface is determined by closing the connection to the reservior and measuring the movement of water surface in the capillary tube during a fixed time period.
Rapid Chloride Permeability Test:
The chloride content ofconcrete can be determined determined by analyzing pulverized concrete samples at various depths using Rapid Chloride Test (RCT) 1029. The RCT measures the acid soluble amount of chlorides as a percentage of concrete mass. A specified amount of chloride powder is extracted and mixed with a vial containing 10 mL of extraction liquid. A potential reading is taken with the RCT chloride electrode and then converted to chloride content in percent of concrete weight using the provided calibration chart.
ENTER DATA
Data Entry
Is the data entered correctly?
Yes - accept data
No - retry and correct
CONTINUE


Corrosion Stains
Are corrosion/rust stains evident on the concrete surface?
Yes
No
corrosion stains present
Exposed Steel
Are any reinforcing steel bars/stirrups/tendons exposed?
Yes
No
steel is exposed
Corrosion Products
Are rust stains or corroded rebar evident under spalled areas?
Yes, light rust
Yes, moderate rust
Yes, extensive rust
No
Unknown
moderate corrosion products are observed on steel
ENTER DATA
Data Entry
Is the data entered correctly?
Yes - accept data
No - retry and correct
CONTINUE


Epoxy Coating
Is the steel reinforcement epoxy coated?
Yes
No
Unknown
the steel is not epoxy coated
Application Time
When was the epoxy coated bar used in this member?
Original construction
During reconstruction or repair
Unknown
it is unknown when/if epoxy coated bars were used
ENTER DATA
Data Entry
Is the data entered correctly?
Yes - accept data
No - retry and correct
CONTINUE


Compressive Stength Values
What was the compressive strength of the core or cylinder, if available?
Less than 1500 psi
Between 1500-3500 psi
Between 3500-4000 psi
Between 4000-4500 psi
Between 4500-5000 psi
Between 5000-5500 psi
Between 5500-6000 psi
Between 6000-6500 psi
Greater than 6500 psi
Unknown
Not applicable (no test data available)
the compressive strength is unknown
ENTER DATA
Data Entry
Is the data entered correctly?
Yes - accept data
No - retry and correct
CONTINUE


Concrete Quality
Based on the information obtained on the member under consideration, please rate the basic quality of the concrete as:
Very good
Good
Average
Marginal
Poor
Unknown
the concrete quality is average
ENTER DATA
Data Entry
Is the data entered correctly?
Yes - accept data
No - retry and correct
CONTINUE


Please click the button to run the analysis:
RUN ANALYSIS
GET RESULT
Diagnosis
Diagnosis 1
Steel Corrosion - Due to Chlorides from Deicing Salts
Extent of Damage
Extent 1
Extensive Damage
Prescribed Repair
Possible Corrective Actions 1
Provide support for the beam as necessary. Remove damaged and spalled concrete and apply a low permeability patch material. Consider the fact that the transfer length of strand has thus been increased by the length of strand exposed during concrete removal.
To protect the prestressed concrete beam-ends against long-term intrusion of chlorides through leaky expansion joints, apply an appropriate surface treatment to the end regions (approximately 2 ft on each end). Refer to the project report for a summary of the effectiveness of various treatments for this application. This surface treatment should ideally be applied in new construction or as early as possible.
It is suggested that efforts be made to limit further chloride contamination of concrete.
It is suggested that the leaky expansion joint be effectively repaired, or consideration be given to retrofitting into a jointless bridge.
Repair expansion joints or consider retrofitting the bridge into a jointless bridge. A major research report prepared by the Construction Technology Laboratories, Inc. (CTL) for the Federal Highway Administration addresses various issues and procedures for retrofitting jointed into jointless bridges

Example 2: Structurally Deficient

Member Observations:

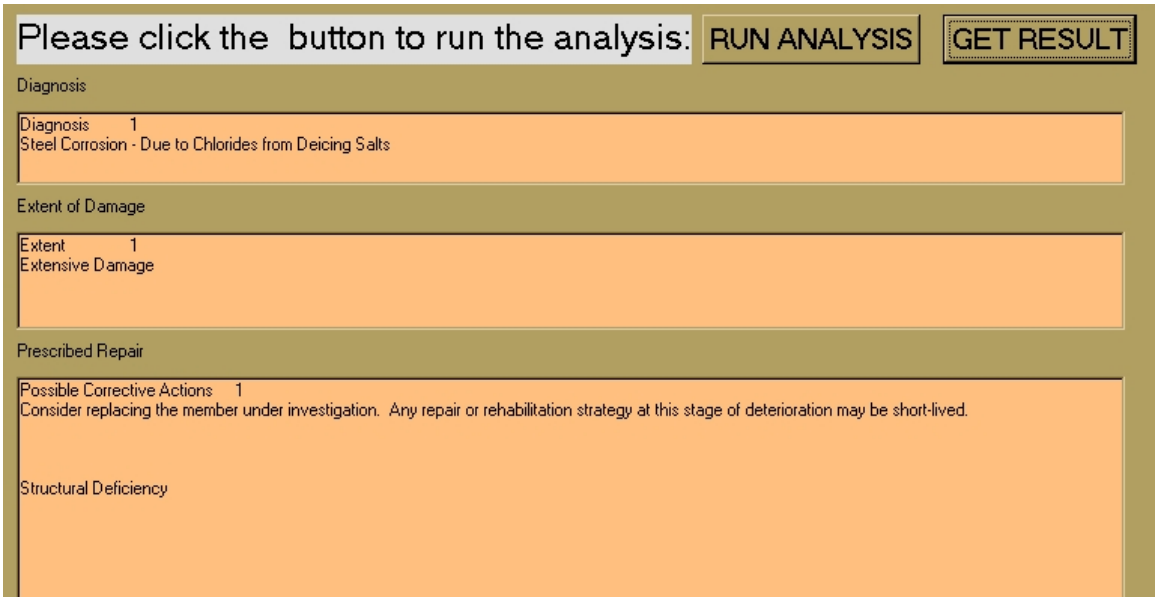
The member under consideration is a pier column located on a 45-year-old two span bridge in Wisconsin. The bridge is located in an urban area with an ADT of over 10,000. The bridge carries a city street and spans over a city street. It is not located near industrial sites. The bridge does carry heavy trucks. There are weight limits posted and the bridge has been classified as structurally deficient, but not functionally obsolete. It has been assigned a rating of three. No vehicle impact damage has occurred. Some previous patch repairs have been performed on the column. More than 8% of the member has been patched with a portland cement patch. The condition of the patch is not very good, but the patches have not spalled yet. It is unknown when the first patch material was placed, but the most recent patch work was completed 8 years ago. The bridge does have leaky expansion joints, but no support settlement is observed.

Extensive cracking and spalling is observed. The cracks are orientated randomly and are less than 12 inches in length. The cracks are not related to extraordinary loading and not related to flexural or shear loading. The cracks have not been observed to move noticeably with temperature changes.

No other surface defects such as honeycombing, blistering, or abrasion is observed. New delamination and spalling areas are noted

No alkali silica reactivity (ASR) is suspected. The sulfate content is low and the member is not subjected to sulfate contaminated soils. The depth of the carbonation front is unknown. The member is exposed to deicing salts. Testing for chloride content has not been performed. The permeability of the concrete is medium. Corrosion stains are observed on the concrete, and no exposed steel is observed. The compressive strength of concrete is unknown. The overall concrete quality can be given a marginal rating.

A printout of the result page of the ConBAR session for the example detailed above is shown below.



Example 3: Light Damage

Member Observations:

The member under consideration is a pier column located on a 14-year-old three span bridge in Wisconsin. The bridge is located in a rural area with an ADT of 2500. The bridge carries a state highway and spans over a county road. It is not located near industrial sites. The bridge does carry heavy trucks. There are no weight limits posted and the bridge has not been classified as structurally deficient or functionally obsolete. It has been assigned a rating of seven. No vehicle impact damage has occurred and no previous repairs have been performed on the beam. The bridge does not have any drainage issues and no support settlement is observed.

Light craze cracking are observed. The cracks are orientated randomly and are less than 12 inches in length. The cracks are not related to extraordinary loading and not related to flexural or shear loading. It is unknown if the crack planes run through the aggregates and no residue is observed around the cracks. The cracks have not been observed to move noticeably with temperature changes.

No other surface defects such as honeycombing, blistering, abrasion, scaling, or popouts are observed. No delaminations are observed. No spalling is observed.

No alkali silica reactivity (ASR) is suspected. The sulfate content is low and the member is not subjected to sulfate contaminated soils. The depth of the carbonation front is unknown. The member is exposed to deicing salts and the acid-soluble chloride content at the depth of cover

is 0.04% by weight of cement. The acid-soluble chloride content at half of the cover depth is 0.01% by weight of cement. The permeability of the concrete is not measured and is unknown. Corrosion stains are not observed on the concrete. No exposed steel or corrosion products are observed. The steel is epoxy coated and the coating was applied prior to the original construction. The compressive strength of concrete is unknown. The overall concrete quality can be rated as good.

A printout of the result page of the ConBAR session for the example detailed above is shown below.